Unit 2
Theory of Demand, Supply and Market Equilibrium

By: Arun Subedi

Introduction

- The demand and supply are most important factors or forces determining price and quantity in the free market economy.
- Demand is related with the economic activities of the consumers and supply is related with the economic activities of the producers or the suppliers.
- These two factors are like two blades of a scissors. It means that as only one blade of a scissors does not function, likewise one force of the market either demand or supply also can not function without another.
- The integration of these two forces of the market is necessary to determine the equilibrium price and quantity of output.

Theory of Demand

Meaning of Demand

- In the ordinary sense, demand and desire are used as a synonymous.
- But, in economics demand implies more than mere desire.
- Demand is the desire backed with willingness and ability to pay.
- The demand for a commodity is also defined as the quantity which consumers are able and willing to purchase at each possible price during a given period of time, other things remaining the same.

Essential Elements to be Demand

- **Price**
- **Desire**
- **Ability**
- **Willingness**
- **Time Period**

Demand Function

- In mathematical language, a function is a symbolic statement of relationship between a dependent and independent variables.
- Demand function states the functional relationship between demand for a commodity (the dependent variable) and its determinants (the independent variables).
- The determinants of demand are price of the product, price of the related goods, income of the consumer, size of the population, advertisement, etc.

$$\mathbf{Q_X = f(P_X, P_Y, Y, T, P, A, \ldots)} \qquad \mathbf{\ldots (i)}$$

where

Q_X	= Demand for commodity X	P_X	= Price of commodity X
P_Y	= Price of related goods	Y	= Income of the consumer
T	= Taste of the consumer	P	= Size of the population
A	= Advertisement	f	= Functional relationship (depend on)

Demand Function Contd.

- The demand function is based on the law of demand.
- The law of demand states the inverse relationship between quantity demanded for a commodity and its price, other things remaining the same.

$$\mathbf{Q_X = f(P_X)} \qquad \text{... (ii)}$$

where

Q_X = Demand for commodity X

P_X = Price of commodity X

Equation (ii) expresses that demand is an inverse function of its price. It means that when price rises, quantity demanded falls and vice-versa.

Types of Demand Function

1. Linear Demand Function

A demand function is said to be linear when the slope of the demand curve remains constant throughout its length.

$$\mathbf{Q_X = a - bP_X} \qquad \text{... (iii)}$$

where

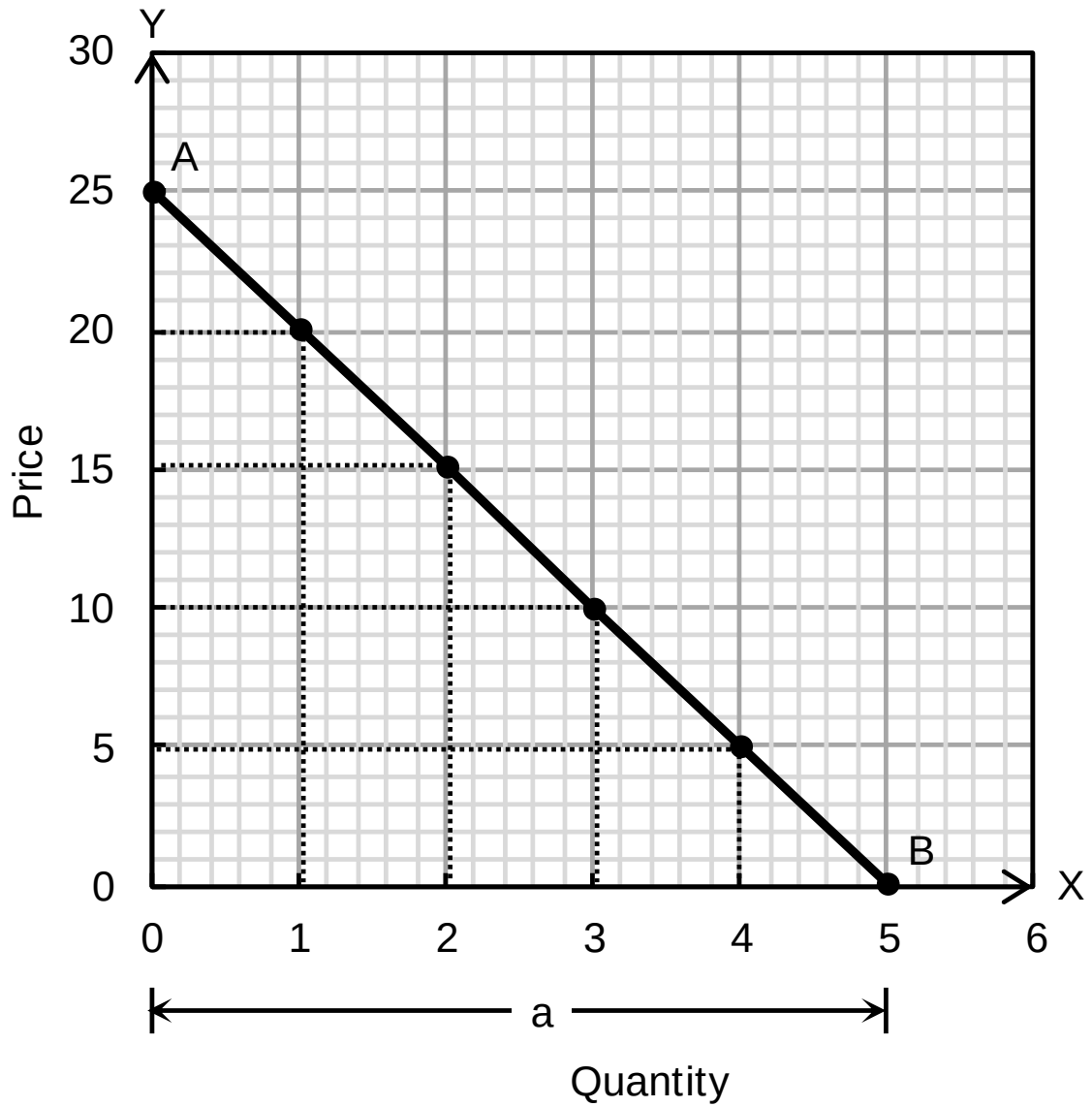
a = Autonomous demand

b = Slope of the demand curve

If the value of 'a' and 'b' are known, total demand (Q_X) for any given price (P_X) can be obtained.

Types of Demand Function Contd.

Linear Demand Schedule	
Price (in Rs.)	Quantity Demanded (in Units)
25	0
20	1
15	2
10	3
5	4
0	5



Types of Demand Function Contd.

Slope of the demand curve (b) is the ratio of the change in quantity demanded to the change in price. Symbolically,

$$b = \left(-\frac{\Delta Q}{\Delta P}\right)$$

where

ΔP = Change in price

ΔQ = Change in quantity demanded

The slope of above demand curve can be calculated using formula.

In the demand schedule given in table.

$\Delta Q = 1, \Delta P = -5$

$$b = -\frac{\Delta Q}{\Delta P} = -\left(\frac{1}{-5}\right) = 0.2$$

Autonomous demand (a) = 5

Hence, demand function: $Q_X = a - bP_X$

or, $Q_X = 5 - 0.2P_X$

Types of Demand Function Contd.

2. Non-linear Demand Function

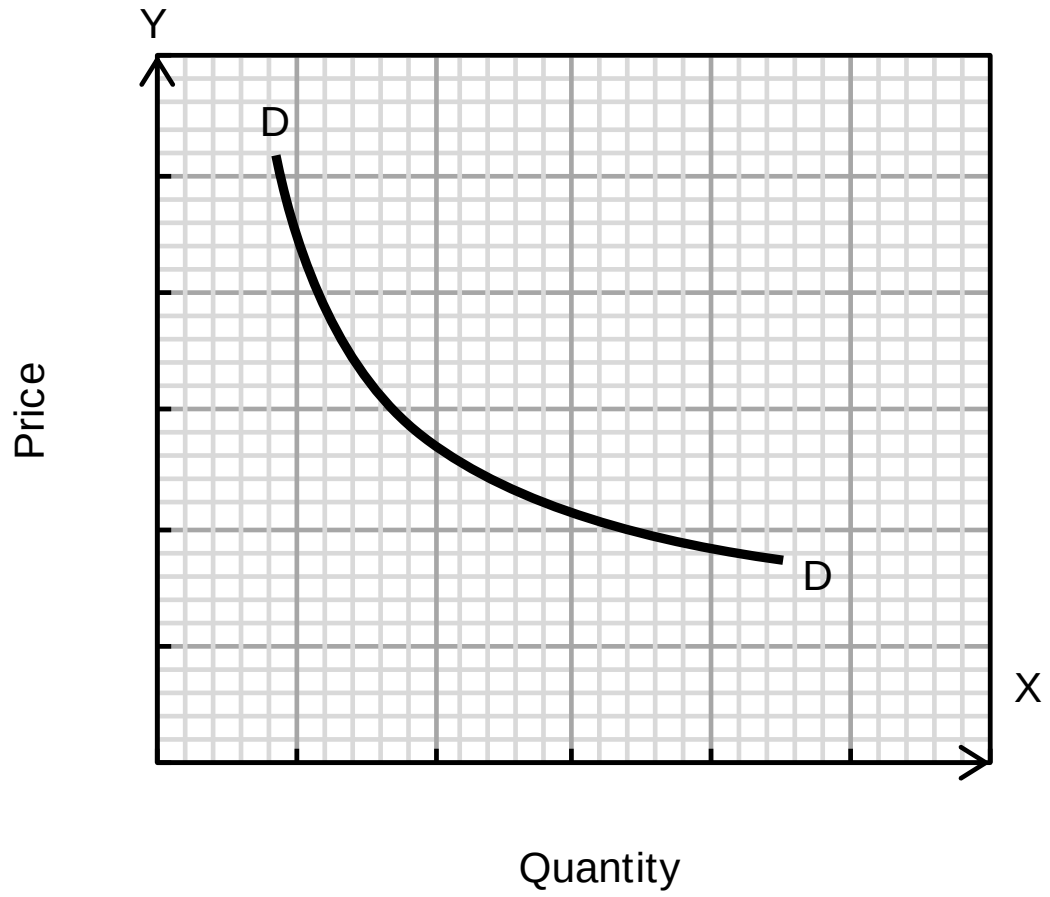
- A demand function is said to be non-linear when the slope of a demand curve changes all along the demand curve.
- Non-linear demand function gives a demand curve instead of a demand line. A non-linear demand function takes the form of a power function as follows:

$$Q_X = aP_x^{-b}$$

or of a rectangular hyperbola of the form

$$Q_X = \frac{a}{P_x^{b}}$$

where a and b > 0



Movement along a Demand Curve and Shift in Demand Curve

Movement along a Demand Curve

- Movement along a demand curve is defined as the change in demand for a commodity due to change in its price, other things remaining the same.
- It is also known as the change in quantity demanded for the commodity.
- When change in demand is caused by change in price, then it is called extension or contraction in demand or change in quantity demanded.
- The concept of extension and contraction in demand is explained as follows:

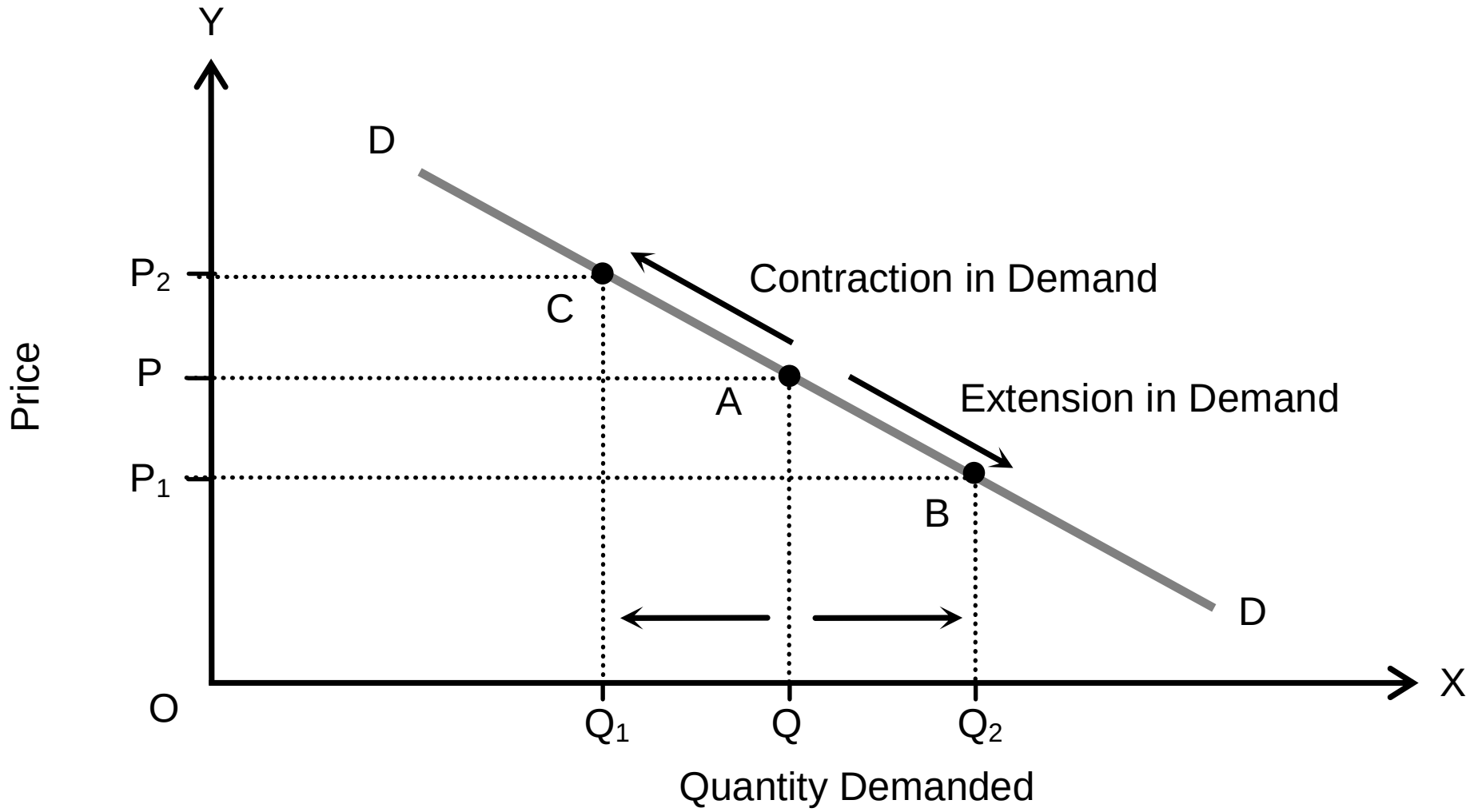
Extension in Demand

- Other things remaining the same, when the quantity demanded for a commodity increases due to fall in its price, it is called extension in demand.
- It is also known as the increase in quantity demanded.

Contraction in Demand

- Other things remaining the same, when the quantity demanded for a commodity decreases due to rise in price, it is called contraction in demand.
- It is also known as the decrease in quantity demanded.

Movement along a Demand Curve Contd.



Movement along a Demand Curve and Shift in Demand Curve Cont…

Shift in the Demand Curve (Change in Demand)

- Shift in demand curve is defined as the change in demand for a commodity due to change in factors other than price of the commodity.
- The other factors include price of related commodities, income of consumer, taste and preferences of the consumer, habit, fashion, size of the population, etc.

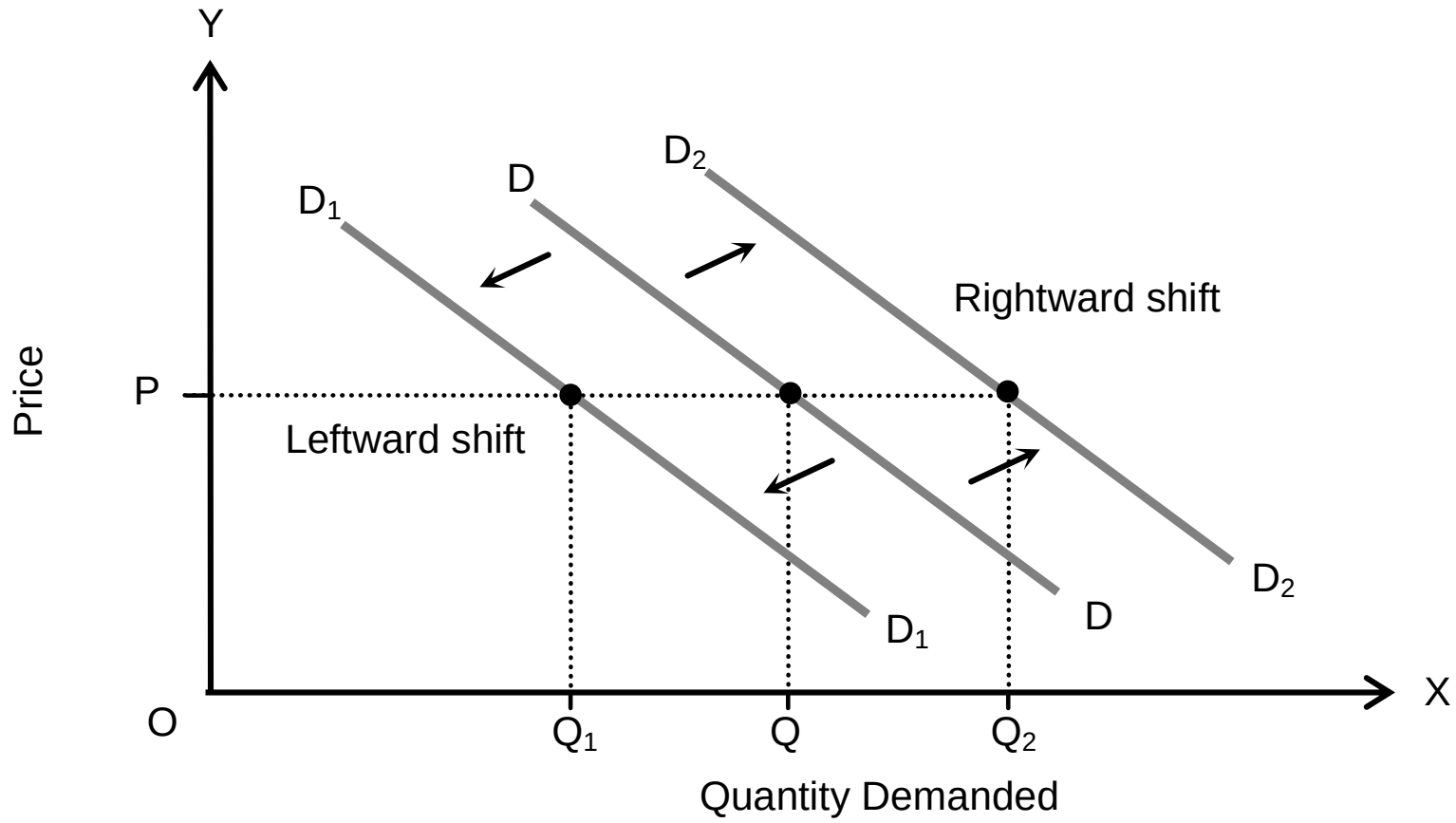
Rightward Shift in the Demand Curve (Increase in Demand)

- Rightward shift in demand curve refers to more demand at the same price of the commodity due to favourable change in factors other than price of the commodity.
- In this situation, the initial demand curve shifts rightward.

Leftward Shift in the Demand Curve (Decrease in Demand)

- Leftward shift in demand curve refers to less demand at the same price of the commodity due to unfavourable change in factors other than price of the commodity.
- In this situation, the initial demand curve shifts towards left.

Shift in the Demand Curve (Change in Demand) Contd.

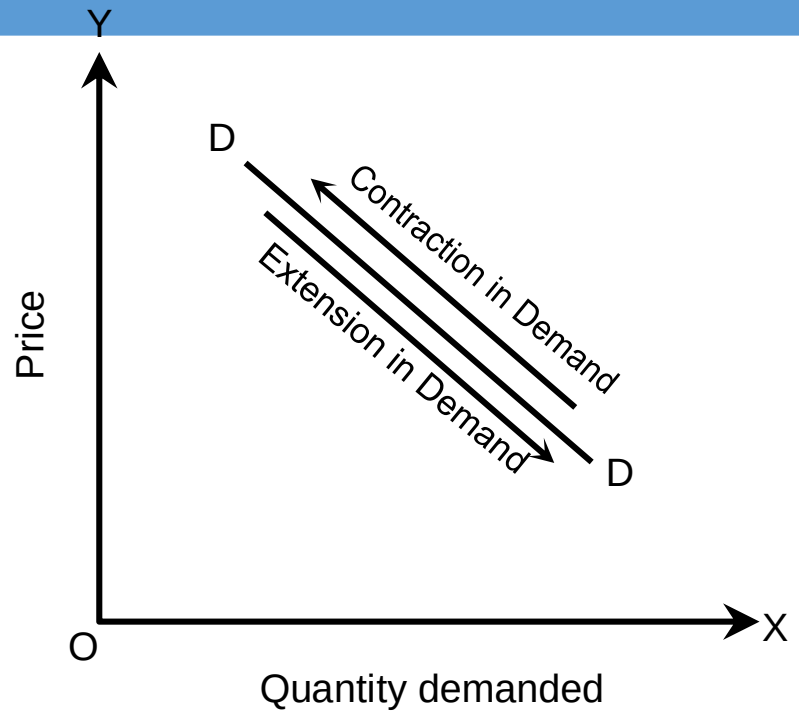


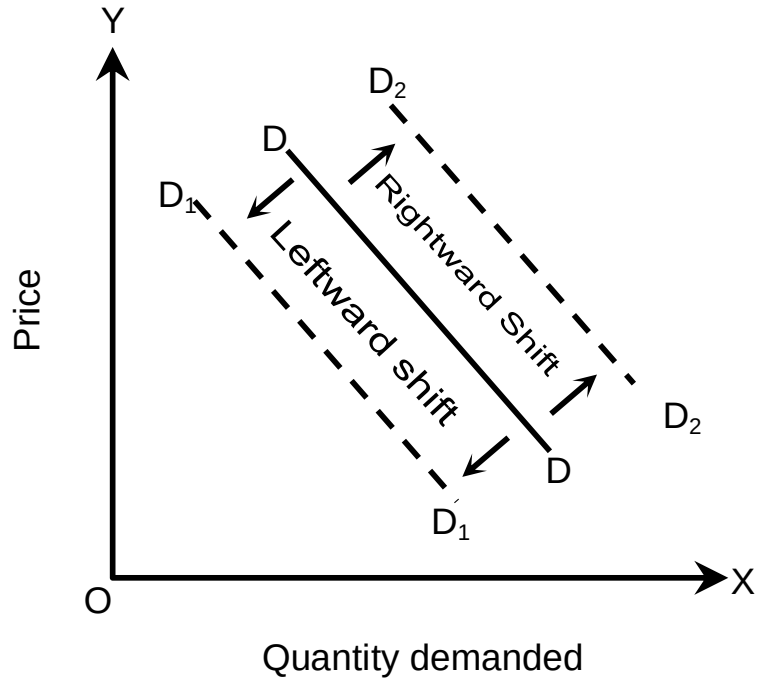
Difference between Movement along a Demand Curve and Shift in the Demand Curve

Movement along a Demand Curve	Shift in the Demand Curve
1. It is caused by the change in the price of the commodity only.	1. It is caused by the change in the factors other than price.
2. It is always along the same demand curve, i.e. no new demand curve is drawn.	2. It is shown by drawing new demand curve.
3. If the quantity demanded for a commodity increases due to fall in price of the commodity, it is called extension in demand. In this case, consumer moves downward along the same demand curve.	3. If the demand for a commodity rises due to favourable change in factors other than price of the commodity, it is called increase in demand. In this case, demand curve shifts towards right.
4. If the quantity demanded for a commodity decreases with a rise in price of the commodity, it is called contraction in demand. In this case, the consumer moves upwards along the same demand curve.	4. If the demand for a commodity falls due to unfavourable change factors other than price of the commodity, it is called decrease in demand. In this case, demand curve shifts towards left.

Difference between Movement along a Demand Curve and Shift in the Demand Curve Contd.

Movement along a Demand Curve	Shift in the Demand Curve
5. It is also called change in quantity demanded.	5. It is also called change in demand.
6. The figure of movement along a demand curve is as follows:	6. The figure of shift in demand curve is as follows:





Factors Causing the Shift in the Demand Curve

1. Change in income of the consumer
2. Change in price of the related goods
3. Change in tastes and preferences of the consumer
4. Change in advertisement expenditure
5. Change in size of population and its composition
6. Change in income distribution
7. Change in the availability of credit
8. Change in expectation

Theory of Supply

Meaning of Supply

- Supply is defined as the quantities of a commodity which its producer or seller is ready to offer for a sale at a given price and period of time.
- It other words, supply is the quantity of a good or service that a producer or seller is willing and able to sell at the given price and time period.

Essential Elements to Be supply

- ❖ **Price**
- ❖ **Quantity**
- ❖ **Willingness and Ability to Sell**
- ❖ **Time Period**

Supply Function

Supply function is defined as the functional relationship between supply of a commodity and its various determinants.

$$\mathbf{Q_X = f\ (P_X, P_Y, P_f, T, G, \ldots)} \qquad \mathbf{\ldots (i)}$$

where

Q_X = Supply of commodity X

f = Functional relation (depend on)

P_X = Price of commodity X

P_Y = Price of other goods

P_f = Price of factors of production

G = Goals of the producer

T = State of technology

Supply Function Contd.

Supply function is based on the law of supply. The law of supply states the positive relationship between the price and the quantity supplied. Other remaining the same, it may be expressed as

$$\mathbf{Q_X = f\ (P_X)} \qquad \text{... (ii)}$$

where

Q_X = Quantity supplied of commodity X

P_X = Price of commodity X

It means that quantity supplied of a commodity is a function of the price of that commodity.

Types of Supply Function

1. Linear Supply Function

- If slope of the supply curve remains constant throughout its length, it is called linear supply functions.
- In other words, if both dependents and independent variables like quantity supplied and price change at the constant rate, supply function or supply curve will be linear.

$$\mathbf{Q_X = a + b P_X} \quad \text{... (iii)}$$

where

Q_X = Quantity supplied of commodity X

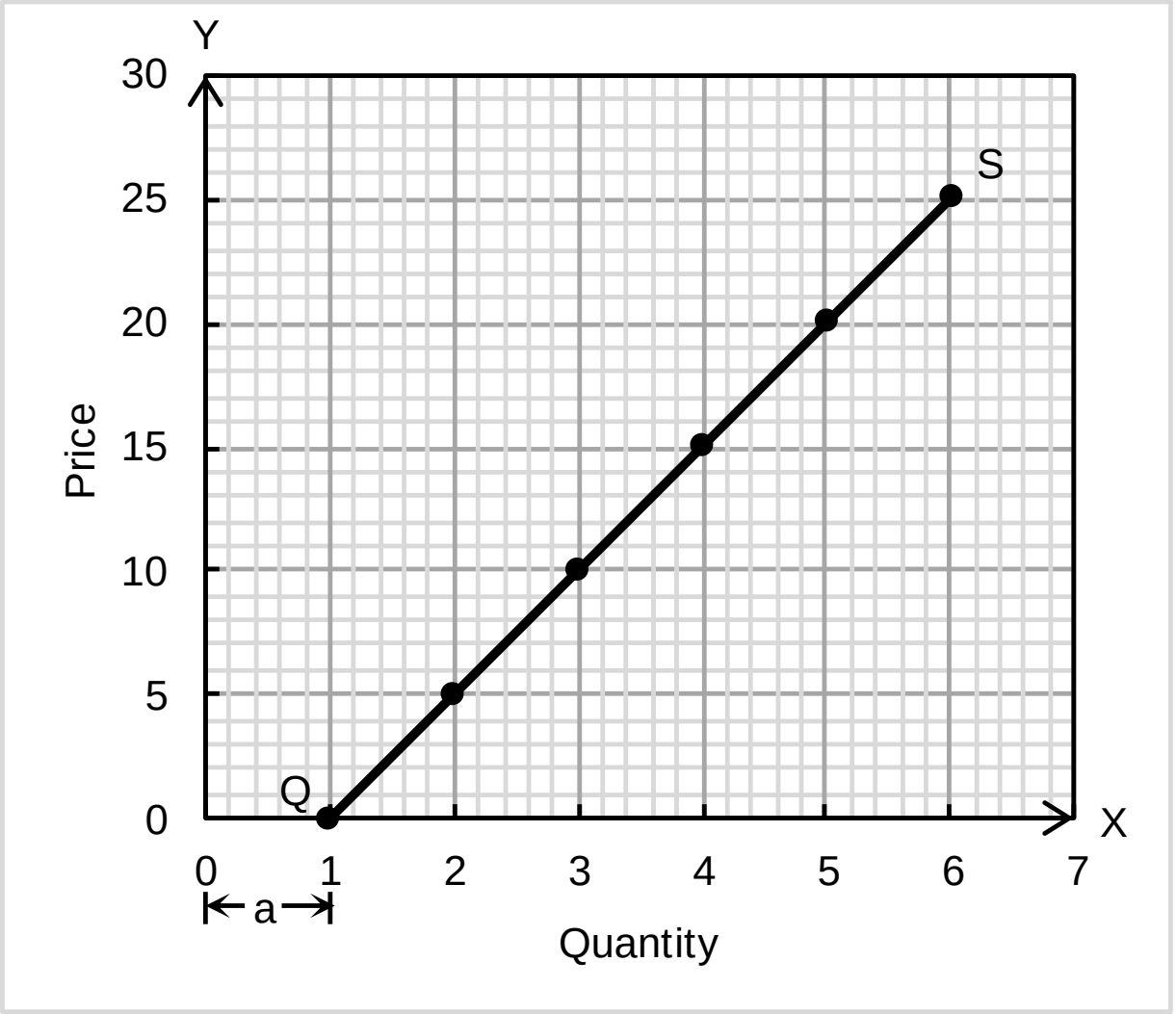
a = X intercept or autonomous supply or quantity supplied at zero price

b = Slope of the supply curve

P_X = Price of the commodity X

Types of Supply Function Contd.

Price (in Rs.)	Quantity Supplied (in Units)
0	1
5	2
10	3
15	4
20	5
25	6



Types of Supply Function Contd.

- In figure, QS represents the linear supply curve or linear supply function. The X–intercept made by the supply curve is 'a'.
- It means that quantity supplied at zero price or autonomous supply is equal to OQ, i.e. 1 unit.
- The slope of supply curve (b) is the ratio of change in quantity supplied (ΔQ) and change in price of the commodity (ΔP).

Slope of the supply curve (b) = $\frac{\Delta Q}{\Delta P}$

In the supply schedule given in table

$\Delta P = 5$, and $\Delta Q = 1$

Thus

Slope of the supply curve (b) = $\frac{\Delta Q}{\Delta P} = \frac{1}{5} = 0.2$

Autonomous supply (a) = 1

Hence, supply function, $Q_X = a + bP_X$

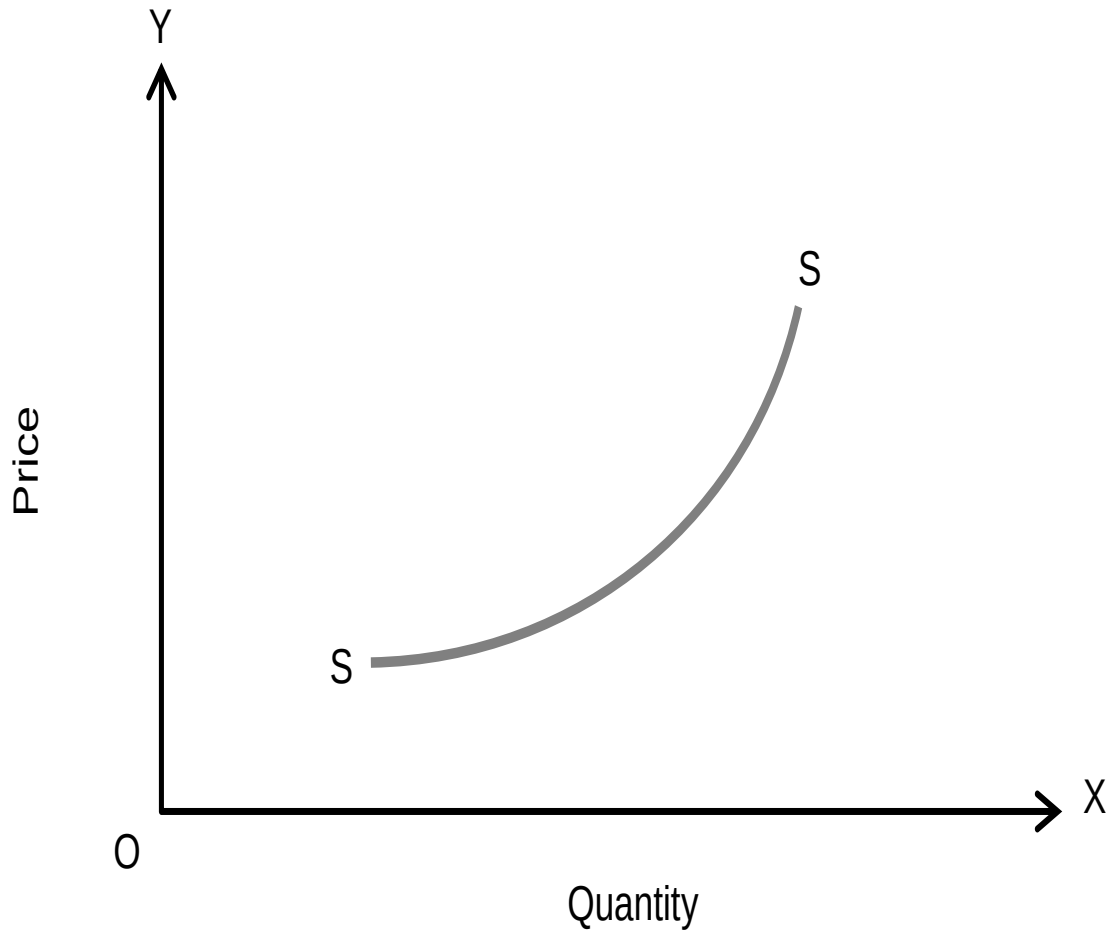
or, $Q_X = 1 + 0.2P_X$

Types of Supply Function Contd.

2. Non-linear Supply function

- If slope of the supply curve changes along the supply curve, it is called non-linear supply function.
- In other words, if both dependent variable and independent variables change at different rates, the supply function is called non-linear supply function.
- It represents non-linear supply curve.

$$Q_X = aP_X^b \qquad \text{... (iv)}$$



Movement along a Supply Curve

- Movement along a supply curve is defined as the change in supply of a commodity to change in its price, other things remaining the same.
- It is also known as the change in quantity supplied of the commodity.

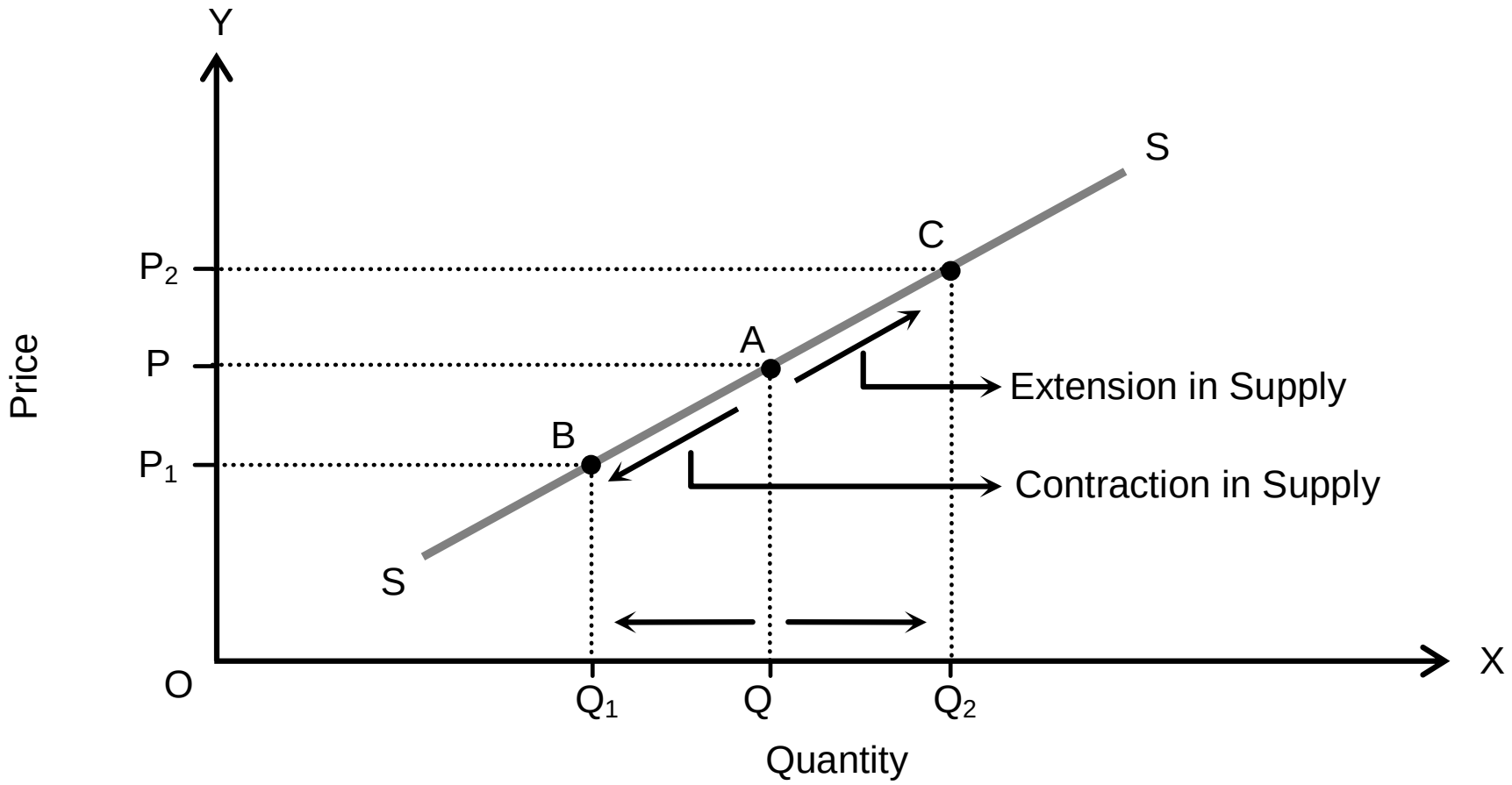
Extension in Supply

- Other things remaining the same, when the more quantities of a commodity are supplied with the rise in its price, it is called extension in supply.
- It is also known as the increase in quantity supplied.
- In this case, we move upward along the same supply curve.

Contraction in Supply

- Other things remaining the same, when the quantity supplied of a commodity decreases due to fall in its price, it is called contraction in supply.
- It is also known as the decrease in quantity supplied.
- In this case, we move downward along the same supply curve.

Movement along a Supply Curve Contd.



Shift in Supply Curve (Change in Supply)

- Shift in supply curve is defined as the change in supply of a commodity due to change in factors other than price the commodity.
- Other factors include the price of the related goods, state of technology, goal of the firm, cost of production, government policy, etc.
- A change in any of these factors causes shift in supply curve at the constant price of the commodity.
- It is also known as change in supply.
- There are two types of shift in supply curve, which are as follows:

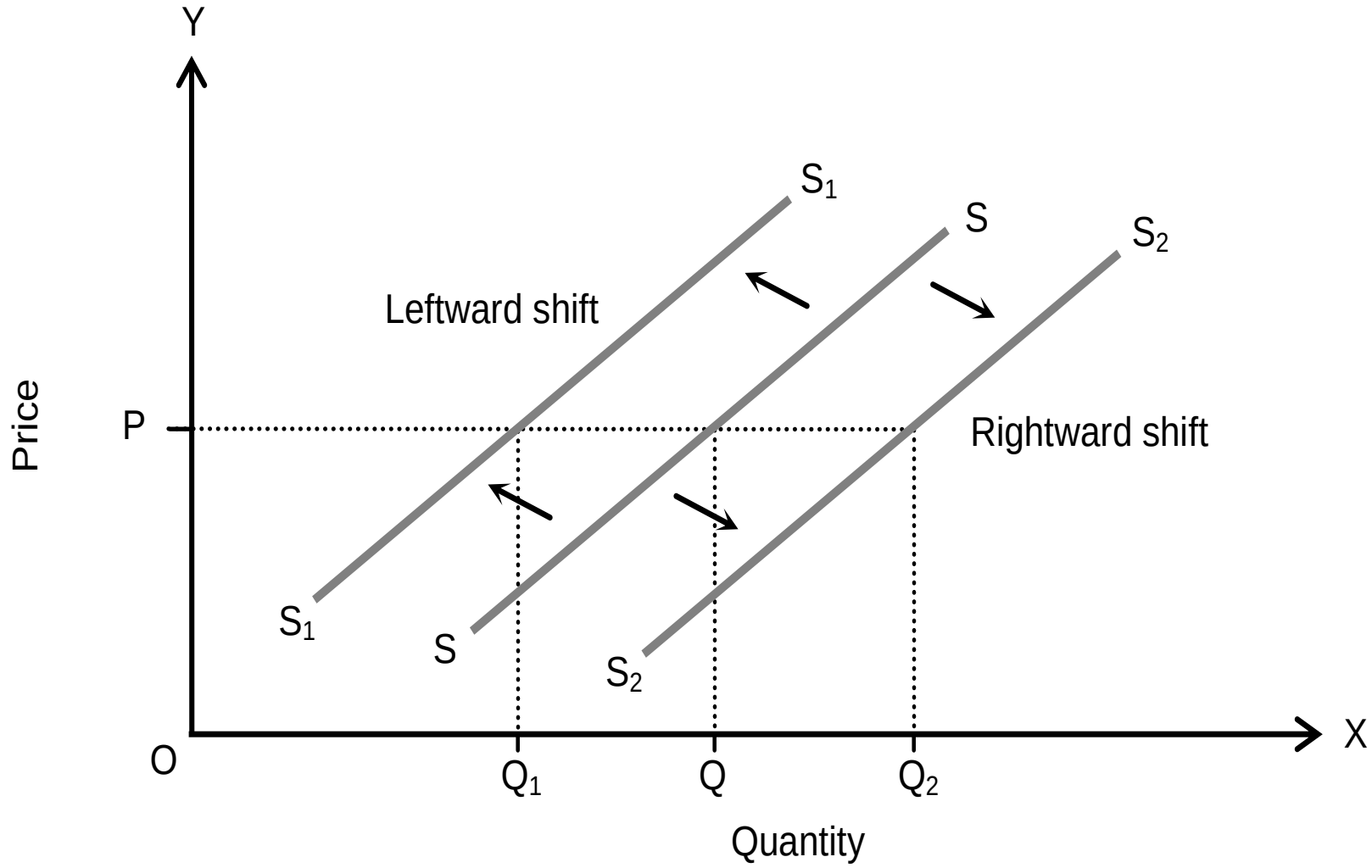
Rightward Shift in Supply Curve (Increase in Supply)

When supply of a commodity increases due to favourable change in the factors other than price of the commodity, it is called increase in supply.

Leftward Shift in Supply Curve (Decrease in Supply)

When supply of a commodity decreases due to unfavourable change in factors other than its price of the commodity, it is called decrease in supply.

Shift in Supply Curve (Change in Supply) Contd.



Difference between Movement along a Supply Curve and Shift in Supply Curve

Movement along a supply curve	Shift in supply curve
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2. It is always along the same supply curve, i.e. no new supply curve is drawn.	2. It is shown by drawing new supply curve.
3. If the quantity supplied of a commodity increases due to rise in price of the commodity, it is called extension in supply. In this case, producer moves upward along the same supply curve.	3. If the supply of a commodity rises due to favourable change in factors other than price of the commodity, it is called increase in supply. In this case, supply curve shifts towards right.
4. If the quantity supplied of a commodity decreases with a fall in price of the commodity, it is called contraction in supply. In this case, the consumer moves downwards along the same supply curve.	4. If the supply of a commodity falls due to unfavourable change factors other than price of the commodity, it is called decrease in supply. In this case, supply curve shifts towards left.

Difference between Movement along a Supply Curve and Shift in Supply Curve

Movement along a supply curve	Shift in supply curve
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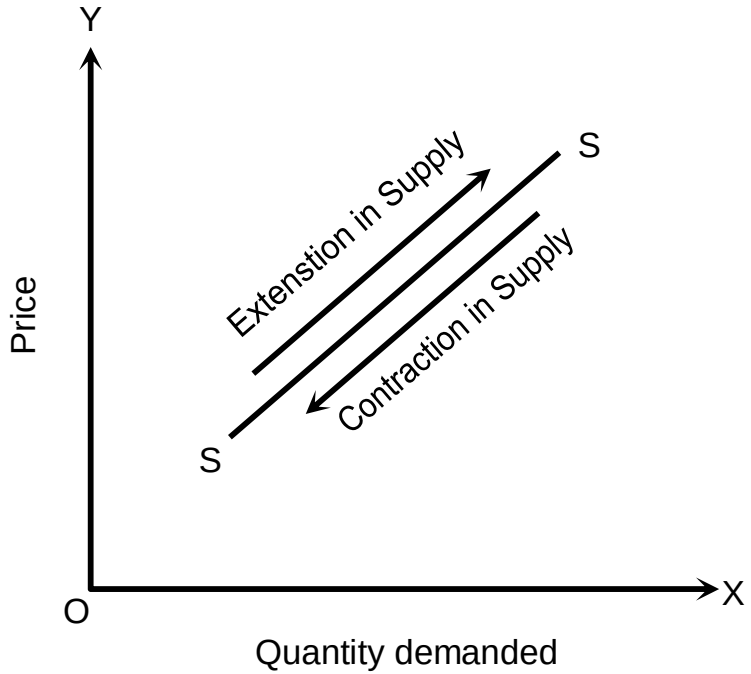
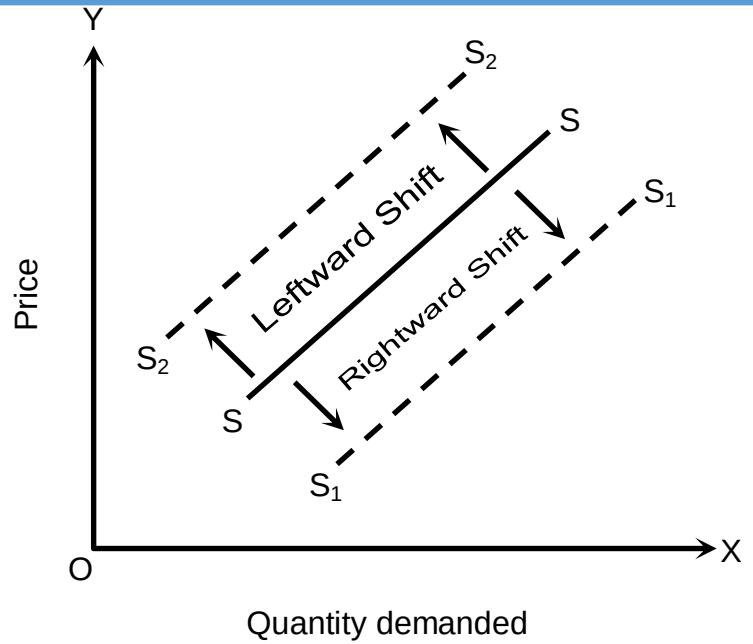




Factors Causing Shift in Supply Curve

1. Change in price of the others goods
2. Change in price of the factors of production
3. Change in goal of the firm
4. Change in technology
5. Change in government policy
6. Change in expectation
7. Change in number of firms

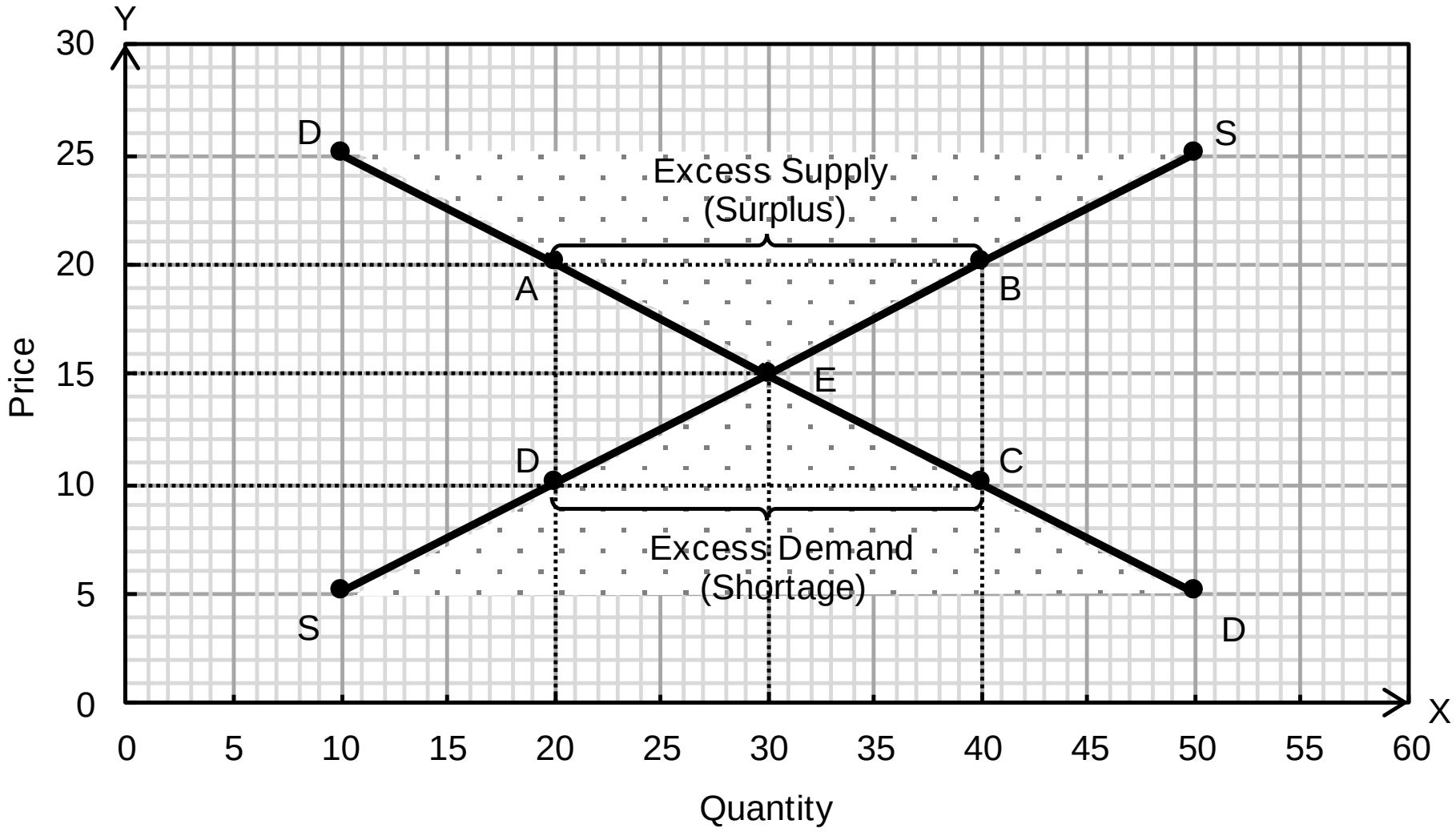
Market Equilibrium

- In the ordinary sense, equilibrium means balance between opposite forces.
- In the context of market analysis, equilibrium refers to a state of market in which quantity demanded for a commodity equals to the quantity supplied of the commodity.
- The equality of demand and supply gives an equilibrium price. It means that equilibrium price is the price at which quantity demanded equals to quantity supplied.
- Similarly, equilibrium quantity is the quantity demanded and supplied at the equilibrium price.

Market Equilibrium Contd.

Monthly Demand and Supply Schedules for Potato				
Price (Rs./Kg.)	Quantity Demanded	Quantity Supplied	Surplus (+) Shortage (–)	Pressure on Price
5	50	10	– 40	Upward
10	40	20	– 20	Upward
15	30	30	0	Equilibrium
20	20	40	20	Downward
25	10	50	40	Downward

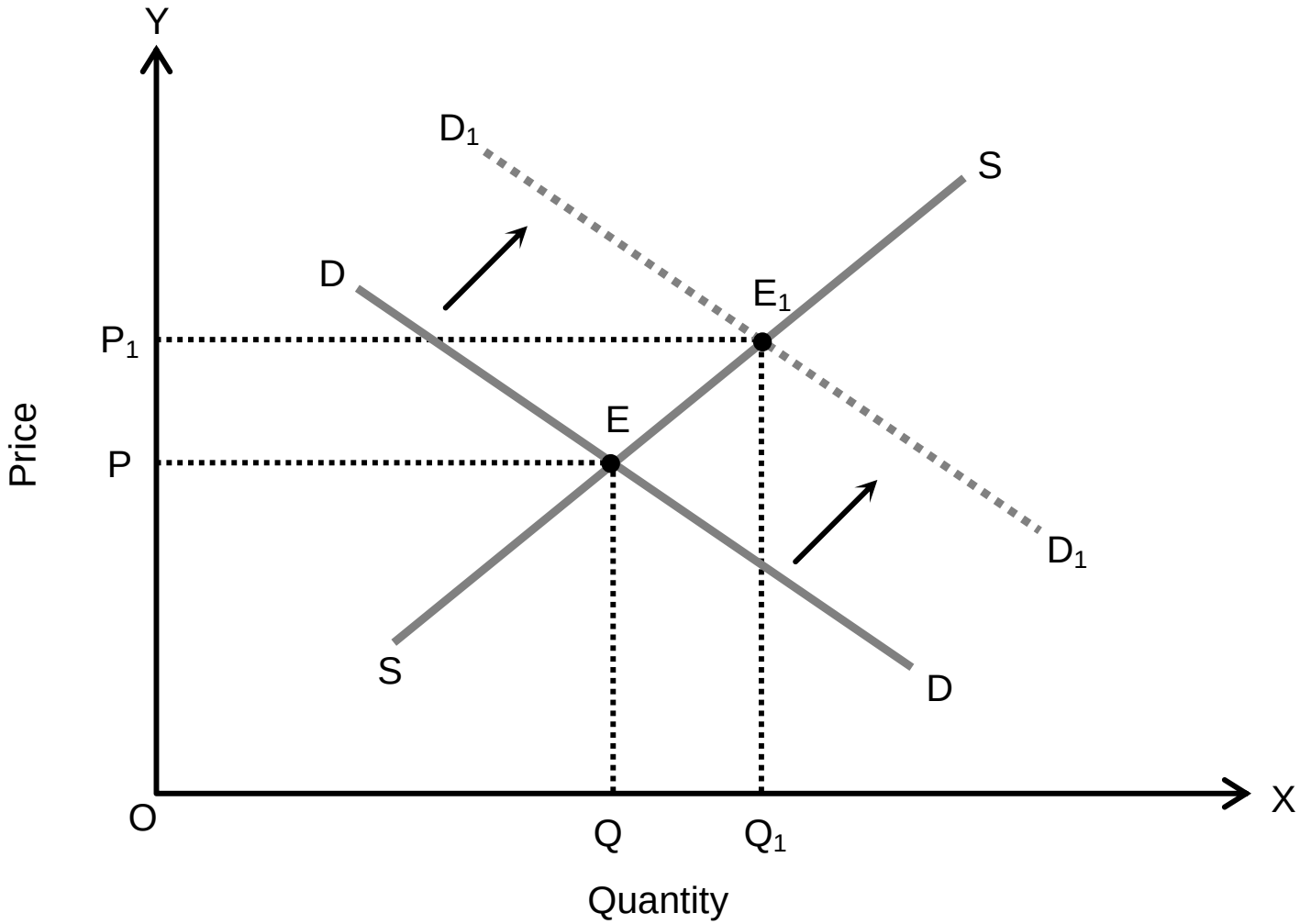
Market Equilibrium Contd.



Change in Market Equilibrium

1. Effect of Shift in Demand Curve

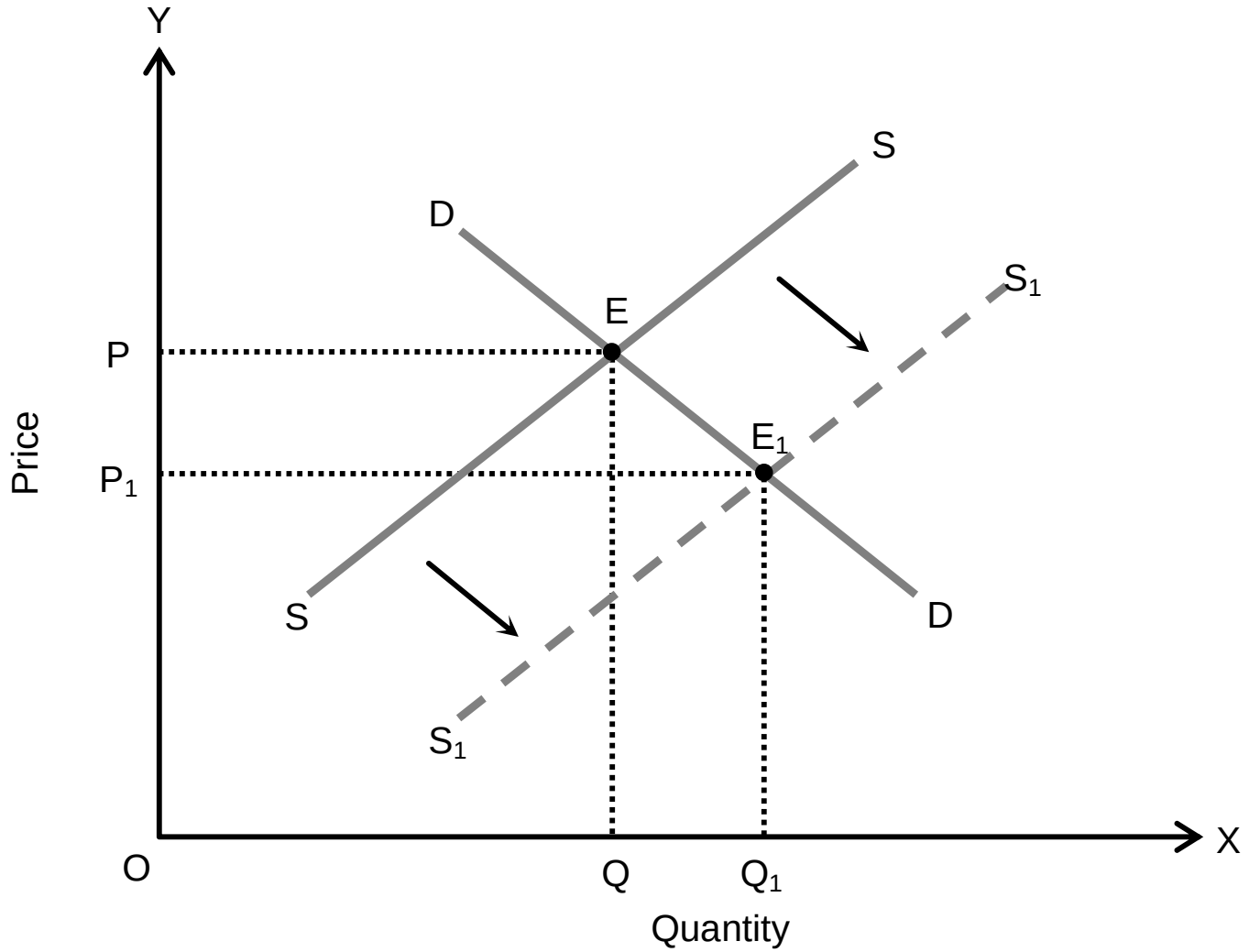
- The shift in demand curve causes change in market equilibrium or change in equilibrium price and quantity.
- If demand curve shifts towards right remaining the supply curve constant, there will be increase in both equilibrium price and quantity of output.



Change in Market Equilibrium Contd.

2. Effect of Shift in Supply Curve

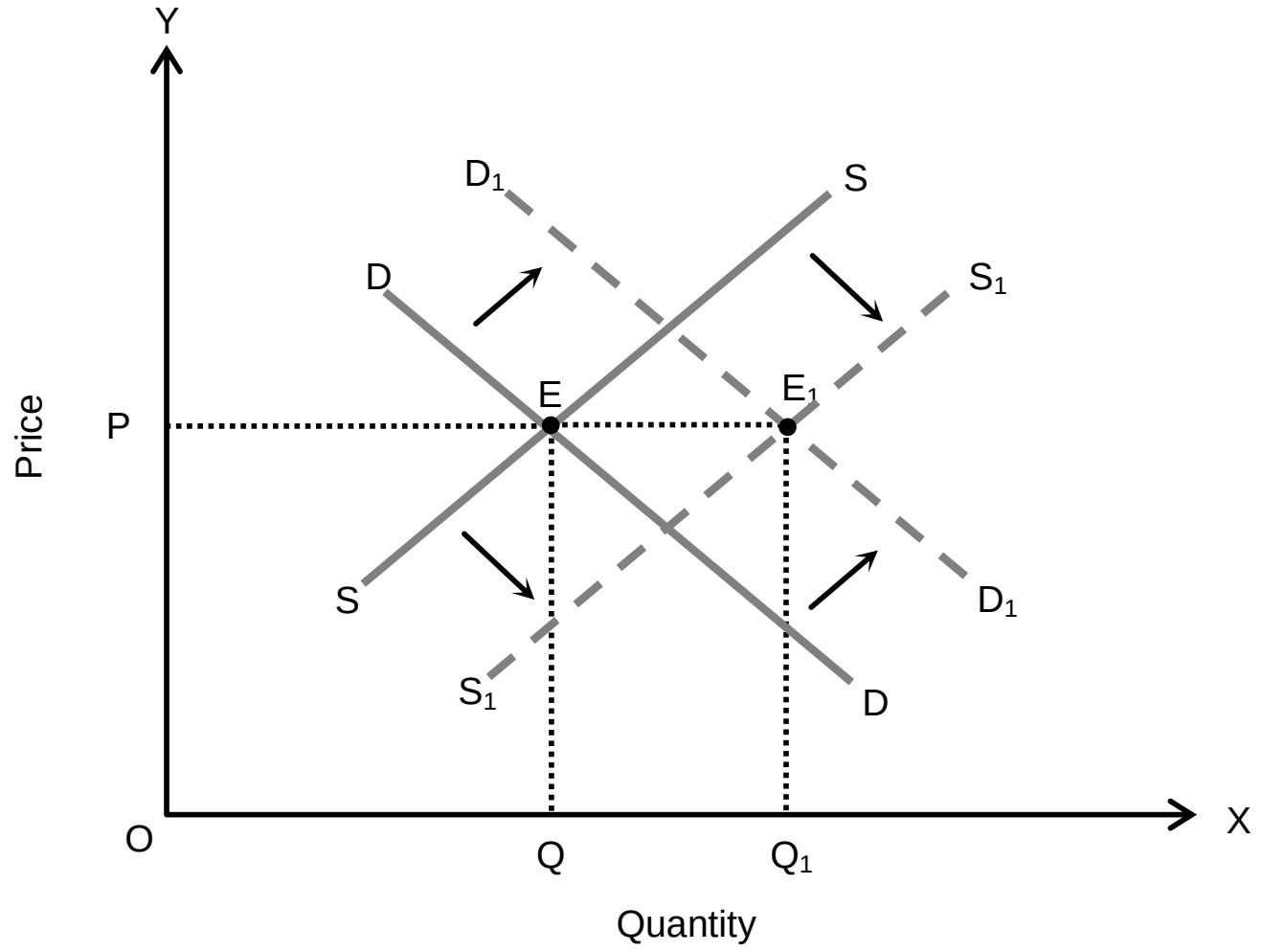
- The shift in supply curve causes change in market equilibrium or change in equilibrium price and quantity.
- If supply curve shifts rightward given the demand curve constant, the equilibrium price decreases but equilibrium quantity of output increases.



Change in Market Equilibrium Contd.

3. Effect of Shift in Both Demand and Supply Curves (Simultaneous Shift in Demand and Supply Curve)

- The effect of simultaneous shift in demand and supply curves depend upon the extent of shift in them.
- If relative shift in demand and supply curves are equal and parallel, equilibrium price will remain same but quantity of output will change.



Elasticity of Demand and Types

Meaning/ Definition of Elasticity of Demand

The elasticity of demand is the measure of responsiveness of demand for a commodity to the change in any of its determinants, such as price of the same commodity, price of the related commodities, consumer's income, tastes and preferences of the consumer, consumer's expectations regarding prices, etc.

Types of Elasticity of Demand

1. Price elasticity of demand
2. Income elasticity of demand
3. Cross elasticity of demand

Price Elasticity of Demand (E_P)

- Price elasticity of demand is defined as the responsiveness of change in quantity demanded of a commodity to the change in its price.
- In other words, the price elasticity of demand is defined as the ratio of percentage change in quantity demanded to the percentage change in price.

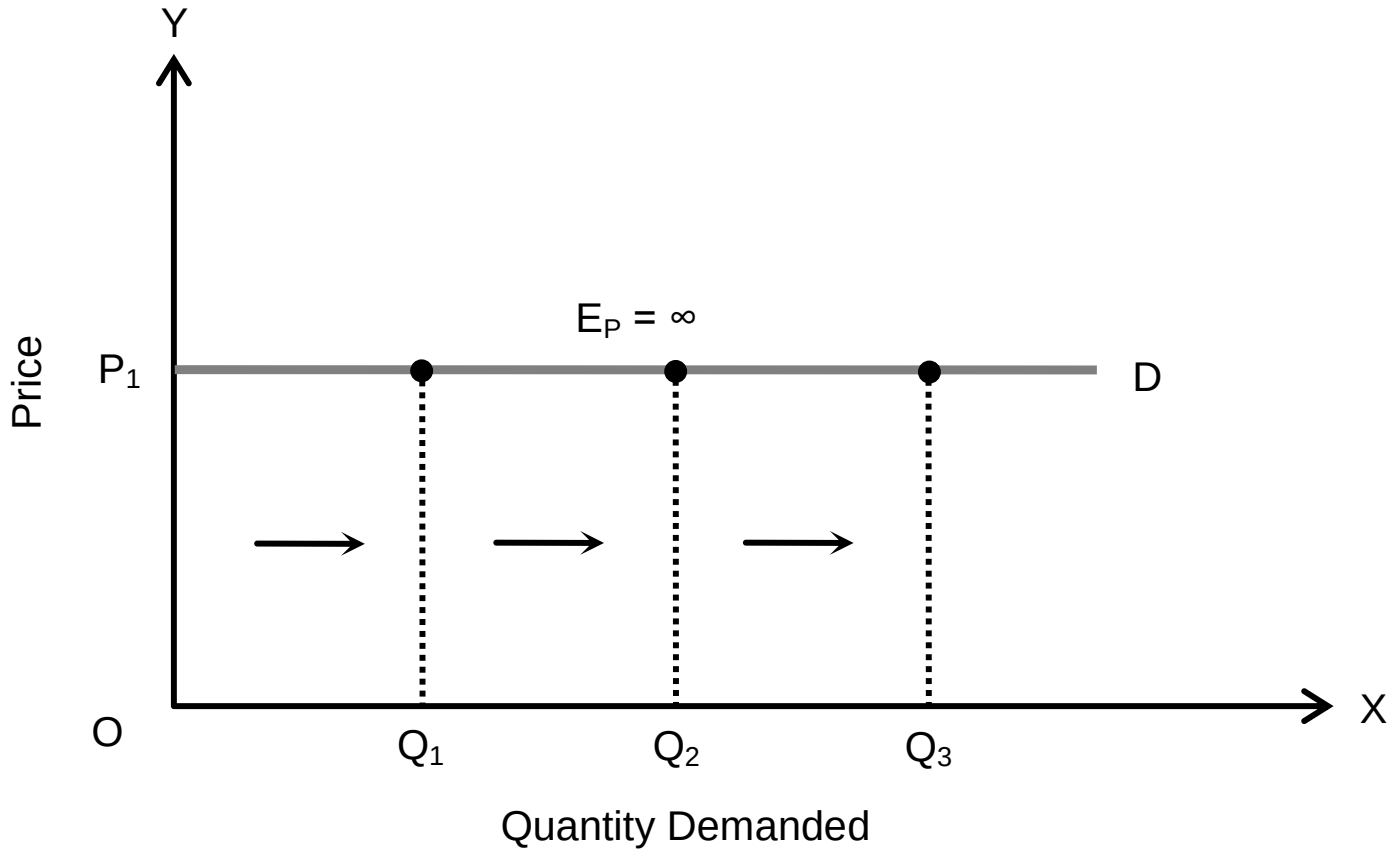
$$E_P = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

$$= \frac{\dfrac{\text{Change in quantity demanded}}{\text{Initial Quantity demanded}} \times 100}{\dfrac{\text{Change in price}}{\text{Initial Price}} \times 100} = \frac{\dfrac{\Delta Q}{Q} \times 100}{\dfrac{\Delta P}{P} \times 100} = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

Types (Degrees) of Price Elasticity of Demand

1. Perfectly Elastic Demand ($E_P = \infty$)

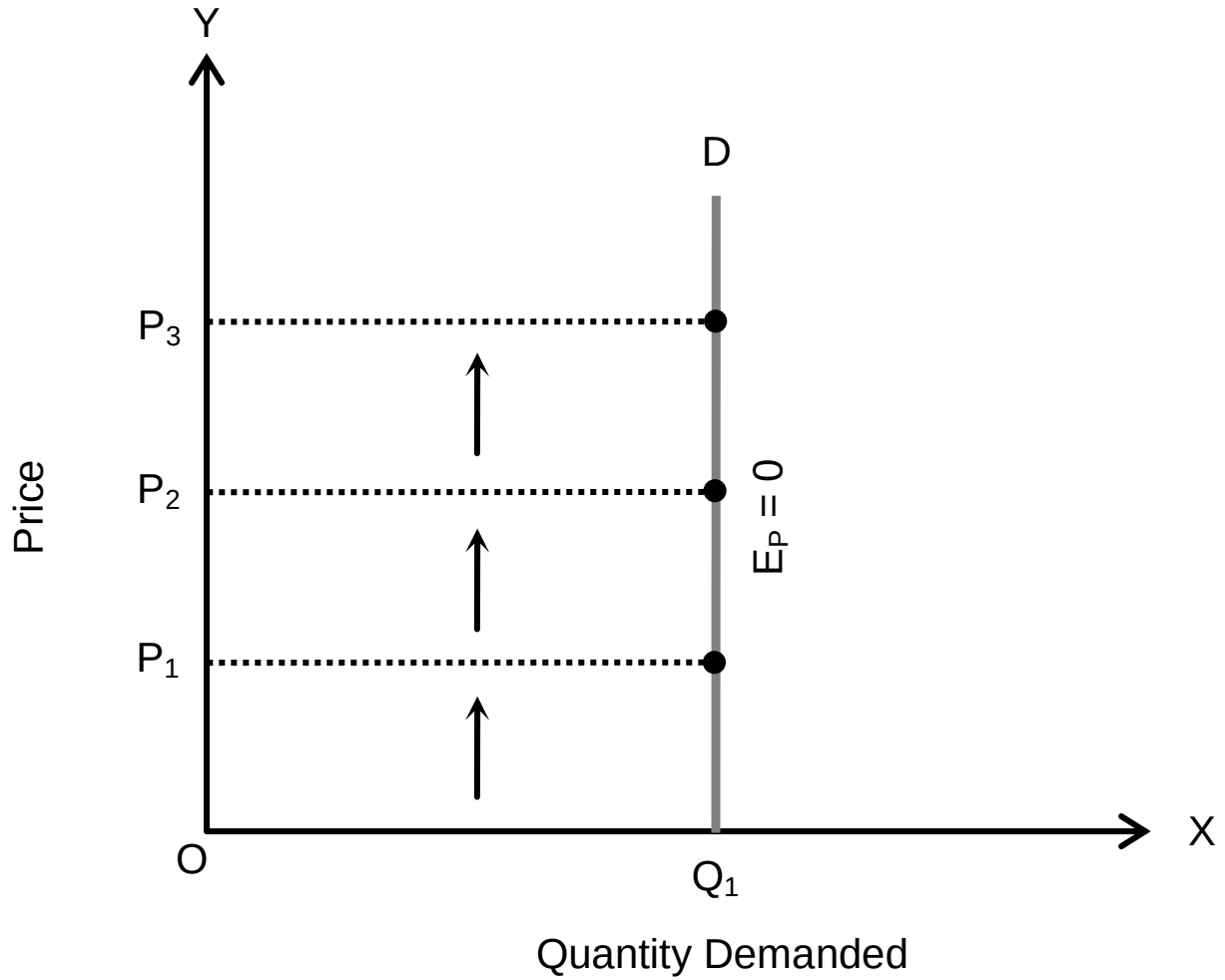
- Demand is said to be perfectly elastic if negligible change in price leads to infinite change in the quantity demanded.
- Perfectly elastic demand is theoretical concept.
- It is hardly found in practice or real life.



Types (Degrees) of Price Elasticity of Demand Contd.

2. Perfectly Inelastic Demand ($E_p = 0$)

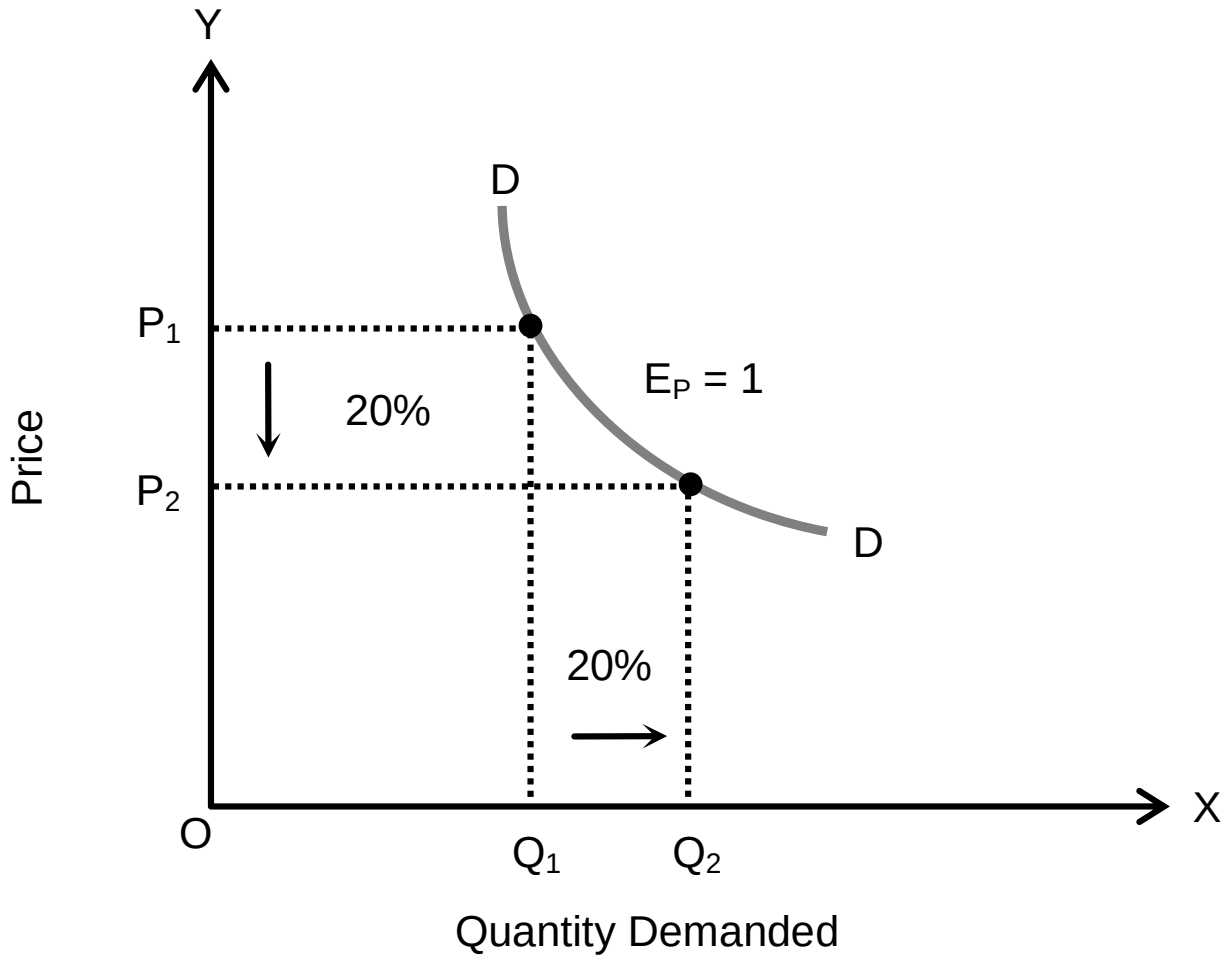
- When the demand for a commodity does not change with the change in its price, the demand is said to be perfectly inelastic.
- For example, medicine and salt have perfectly inelastic demand.



Types (Degrees) of Price Elasticity of Demand Contd.

3. Unitary Elastic Demand ($E_P = 1$)

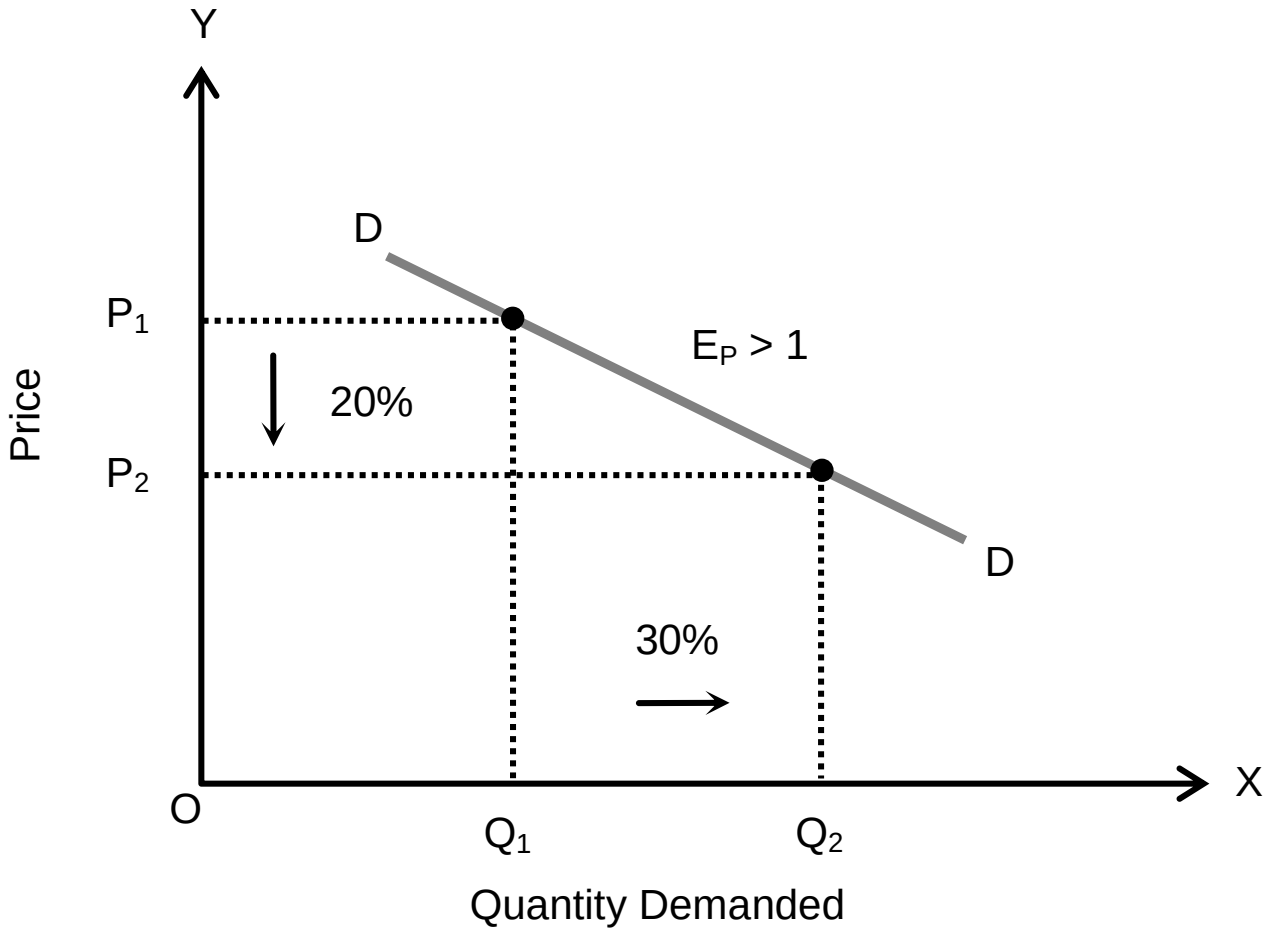
- When the percentage change in the quantity demanded is equal to the percentage change in price, the demand for a commodity is said to be unitary elastic demand.
- For example, if a 20% change in price causes 20% change in demand, it is the case of unitary elastic demand.



Types (Degrees) of Price Elasticity of Demand Contd.

4. Relatively Elastic Demand ($E_p > 1$)

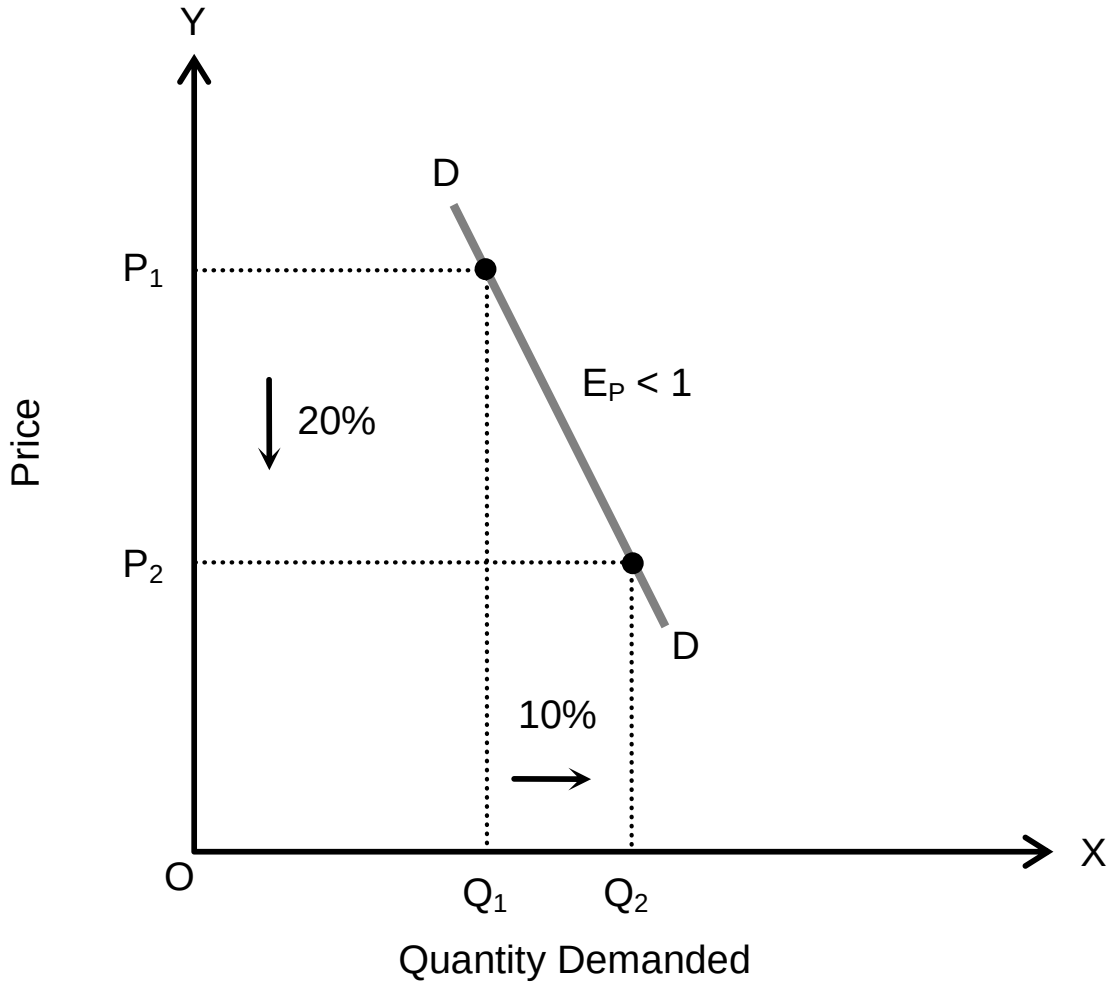
- When the percentage change in the quantity demanded for a commodity is more than percentage change in its price, it is called relatively elastic demand.
- Such kind of elasticity of demand is found in case of luxury goods like LED television, refrigerator, car, etc.



Types (Degrees) of Price Elasticity of Demand Contd.

5. Relatively Inelastic Demand ($E_P < 1$)

- If the percentage change in the quantity demanded for a commodity is less than the percentage change in its price, it is called relatively inelastic demand.
- It is found in case of necessity or basic good like rice, vegetable, clothes, etc.



Methods of Measuring Price Elasticity of Demand

1. Percentage Method

- Percentage method was developed by **Prof. Flux** as an improvement over the outlay method. The price elasticity of demand is measured by its coefficient.
- The coefficient (E_P) measures the percentage change in the quantity demanded of a commodity resulting from a given percentage change in its price.
- According to this method, E_P is calculated by using following formula:

$$E_P = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

$$= \frac{\frac{\Delta Q}{Q} \times 100}{\frac{\Delta P}{P} \times 100} = \frac{\left(\frac{\Delta Q}{Q}\right)}{\left(\frac{\Delta P}{P}\right)} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

If $E_P > 1$, demand is elastic. If $E_P < 1$, demand is inelastic. If $E_P = 1$, demand is unitary elastic.

Methods of Measuring Price Elasticity of Demand Contd.

2. Point Method (Geometric Method)

- Point method is also an important method of measuring price elasticity of demand. It is also known as the geometric method or graphical method.
- This method was developed by **Alfred Marshall** for measuring price elasticity of demand at a point on a demand curve.
- Therefore, this method is the measure of price elasticity of demand at a particular point of demand curve.
- This method is used when very small change in price of the commodity results in very small change in its quantity demanded.
- In this case, the price elasticity formula can be expressed as

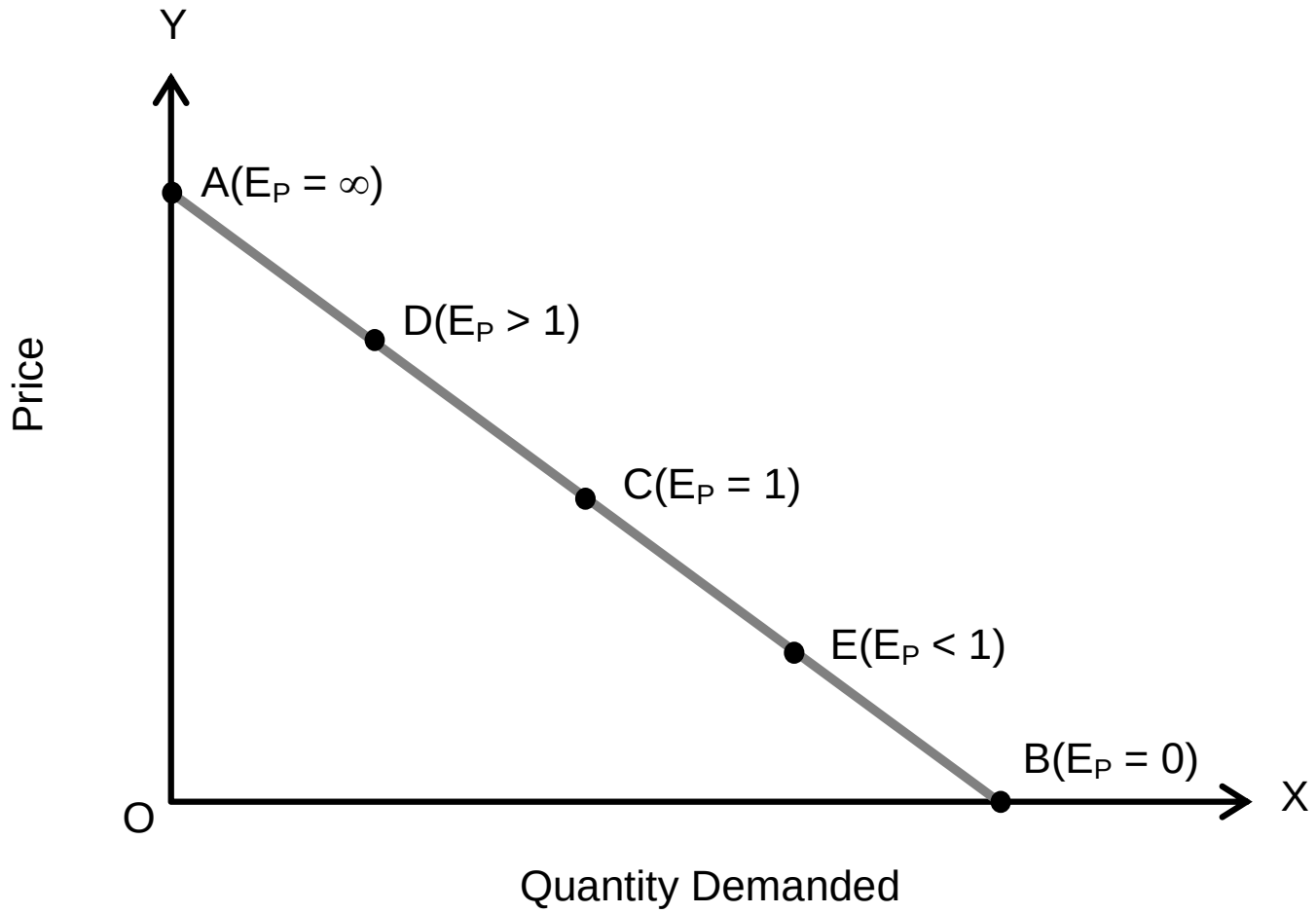
$$E_P = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

Methods of Measuring Price Elasticity of Demand Contd.

i. Point Elasticity on a Linear Demand Curve

By using the above formula of the price elasticity of demand geometrically we can derive the following formula to measure the price elasticity of demand on a straight line demand curve or linear demand curve.

$$E_P = \frac{\text{Lower segment of the demand curve}}{\text{Upper segment of the demand curve}}$$



Methods of Measuring Price Elasticity of Demand Contd.

- The downward sloping curve AB represents linear demand curve. Let us suppose, C as the middle point of the demand curve AB.
- Using the formula of the point elasticity of demand, we can find out coefficient of price elasticity of demand at different points of the demand curve by using point method as follows:

$$E_P \text{ at the point C} = \frac{\text{Lower segment of the demand curve}}{\text{Upper segment of the demand curve}} = \frac{CB}{AC} = 1 \ (\because CB = AC)$$

Hence, at the point C, demand is unitary elastic.

$$E_P \text{ at the point A} = \frac{\text{Lower segment of the demand curve}}{\text{Upper segment of the demand curve}} = \frac{AB}{0} = \infty$$

Hence, at the point A, demand is perfectly elastic.

$$E_P \text{ at the point D} = \frac{\text{Lower segment of the demand curve}}{\text{Upper segment of the demand curve}} = \frac{DB}{AD} > 1 \ (\because DB > AD)$$

Hence, at the point D, demand is relatively elastic.

Methods of Measuring Price Elasticity of Demand Contd.

$$E_P \text{ at the point E} = \frac{\text{Lower segment of the demand curve}}{\text{Upper segment of the demand curve}} = \frac{EB}{AE} < 1 \quad (\because EB < AE)$$

Hence, at the point E, demand is relatively inelastic.

$$E_P \text{ at the point B} = \frac{\text{Lower segment of the demand curve}}{\text{Upper segment of the demand curve}} = \frac{0}{AB} = 0$$

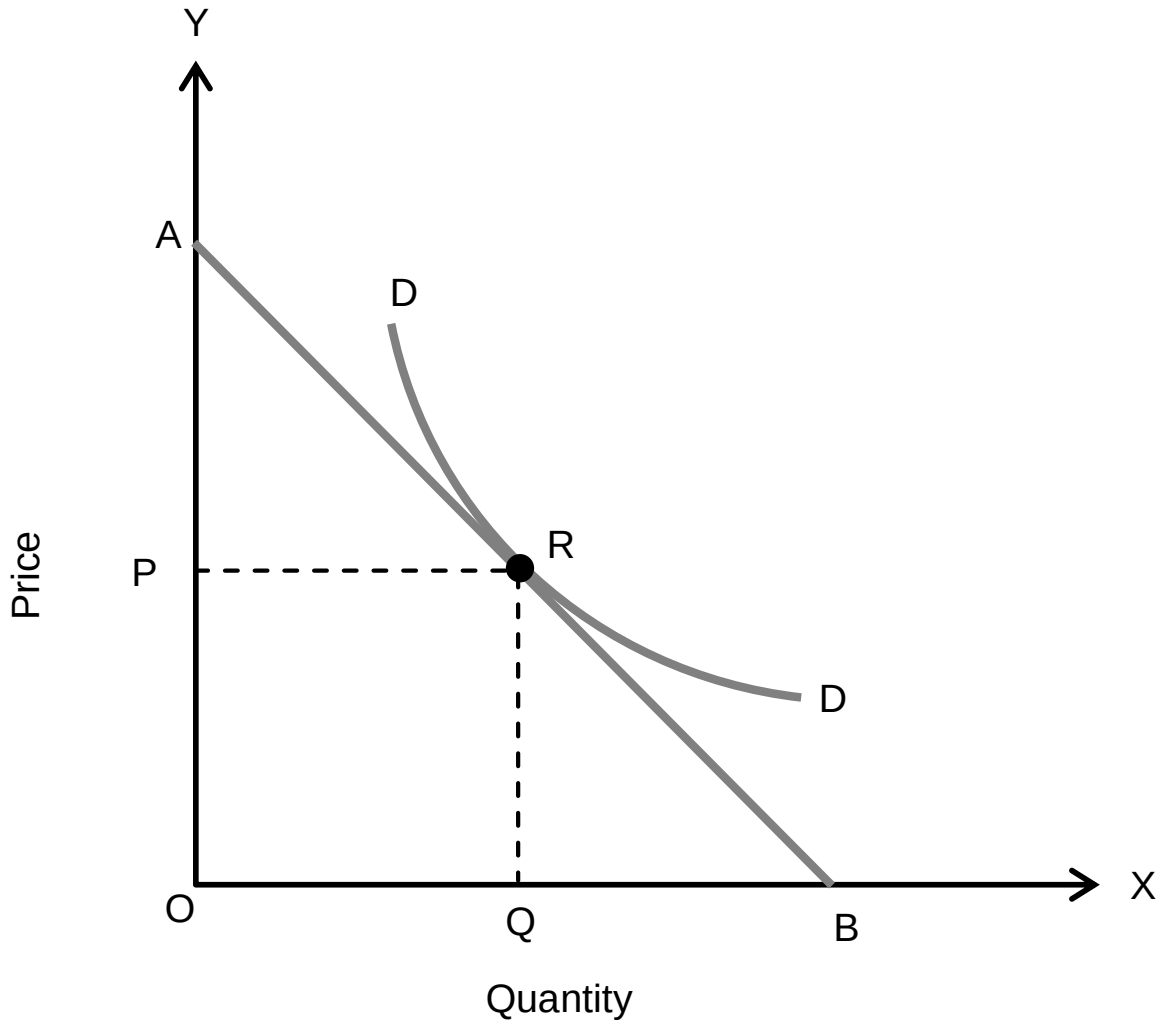
Hence, at the point B, demand is perfectly inelastic.

Methods of Measuring Price Elasticity of Demand Contd.

ii. Point Elasticity on a Non-linear Demand Curve

- Point elasticity on a non-liner demand curve is measured by drawing a tangent to the demand curve at the chosen point and measuring the elasticity of the tangent line at this point.
- The price elasticity of demand at point R is as

$$E_P = \frac{\text{Lower segment of the tangent line}}{\text{Upper segment of the tangent line}} = \frac{RB}{AR}$$



Methods of Measuring Price Elasticity of Demand Contd.

3. Total Outlay Method

- According to this method, we compare total outlay of a consumer before and after the variations in price.
- Total outlay is the price multiplied by the quantity of a good purchased.

Total outlay (Total expenditure) = Price × Quantity purchased

i. **Elasticity greater than unity ($E_p > 1$):** When total expenditure increases with the fall in price and decreases with the rise in price, the demand is said to be elastic demand.

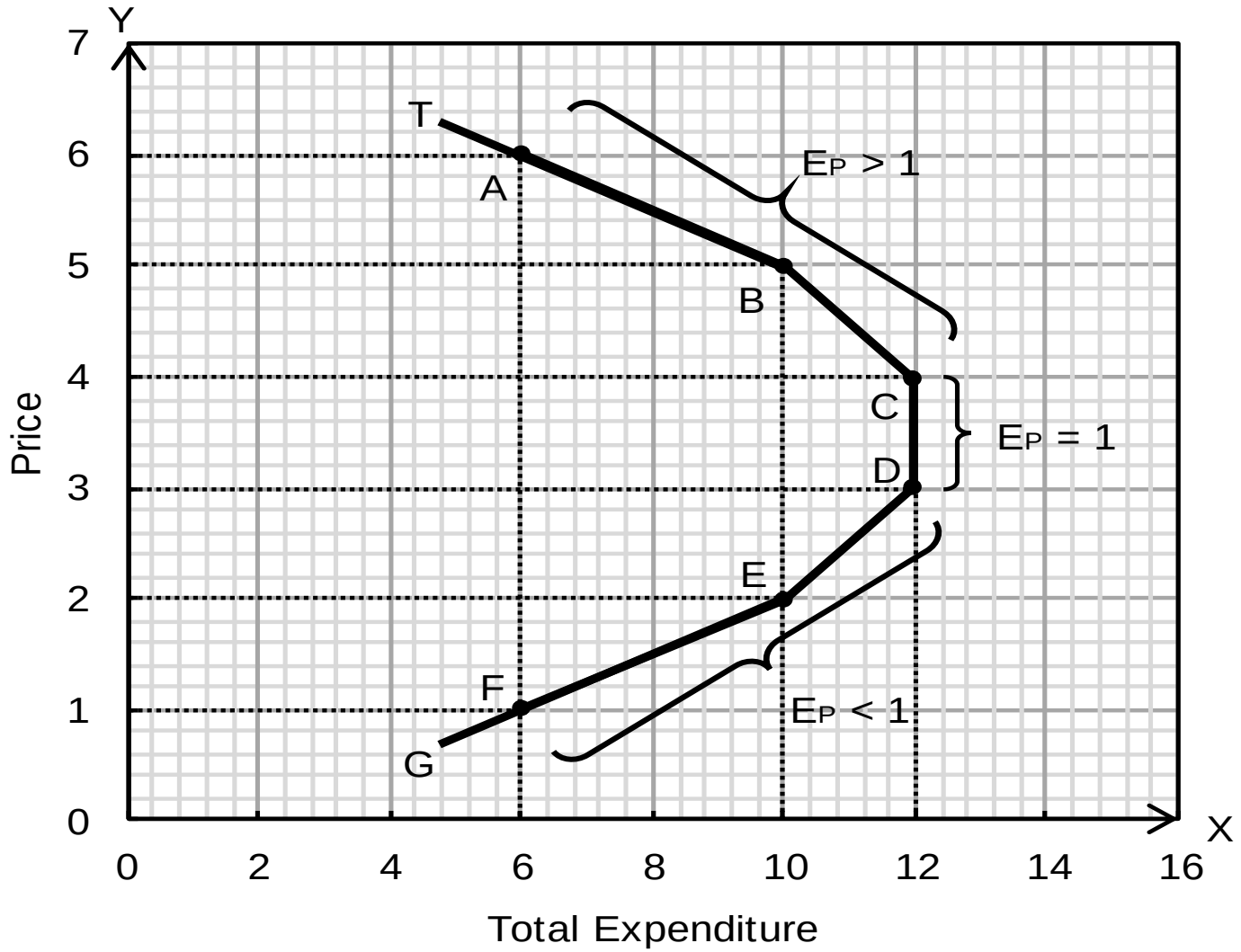
ii. **Elasticity less than unity ($E_p < 1$):** If with the fall in price, the total expenditure decreases and with the rise in price, the total expenditure increases, demand is said to be less than unity.

iii. **Elasticity equal to unity ($E_p = 1$):** When the total expenditure remains unchanged with a fall or rise in price, the price elasticity of demand is said to be equal to unity.

Methods of Measuring Price Elasticity of Demand Contd.

Situation	Price (P) (in Rs.)	Quantity (Q) (in unit)	Total Expenditure TE = P · Q	EP
I	6	1	6	EP > 1
	5	2	10	
II	4	3	12	EP = 1
	3	4	12	
III	2	5	10	EP < 1

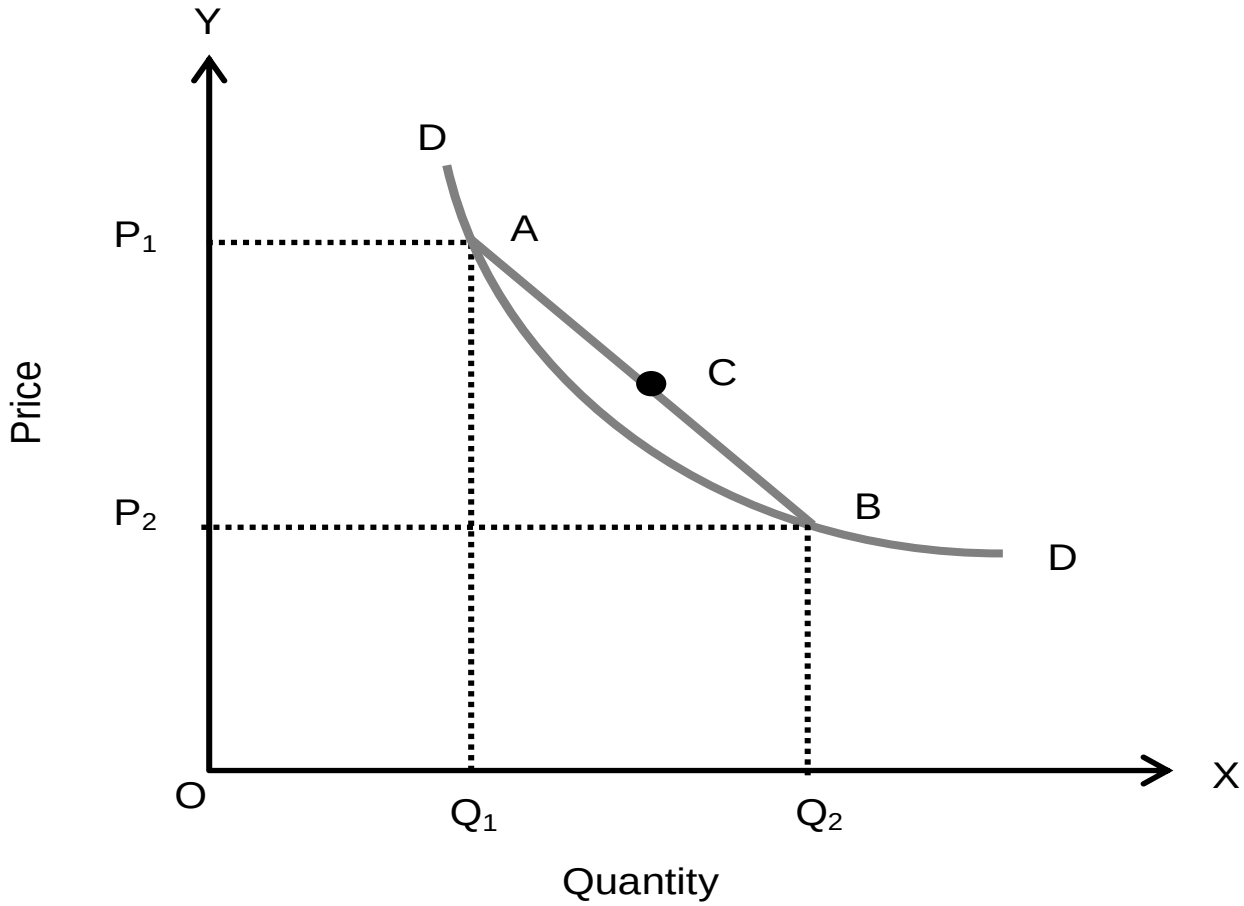
Methods of Measuring Price Elasticity of Demand Contd.



Methods of Measuring Price Elasticity of Demand Contd.

4. Arc Elasticity of Demand

- The coefficient of price elasticity of demand between two points on a demand curve is called arc elasticity of demand.
- This method is used when there is large change in price and quantity demanded.
- Any two points on a demand curve make an arc as in figure.



Methods of Measuring Price Elasticity of Demand Contd.

The formula for measuring price elasticity of demand at the middle point C of the arc on the demand curve is:

$$E_P = \frac{\left(\frac{\text{Change in quantity demanded}}{\text{Average quantity demanded}}\right)}{\left(\frac{\text{Change in Price}}{\text{Average Price}}\right)} = \frac{\frac{\Delta Q}{\frac{Q_1 + Q_2}{2}}}{\frac{\Delta P}{\frac{P_1 + P_2}{2}}}$$

$$= \frac{\Delta Q}{\Delta P} \times \frac{P_1 + P_2}{Q_1 + Q_2} = \left(\frac{Q_2 - Q_1}{P_2 - P_1}\right) \times \frac{P_1 + P_2}{Q_1 + Q_2}$$

where

Q_1 = Initial quantity demanded

Q_2 = New quantity demanded

P_1 = Initial Price

P_2 = New Price

ΔQ = Change in quantity demanded

ΔP = Change in Price

Uses or Importance of Price Elasticity of Demand

1. Monopoly price determination
2. Price determination under discriminating monopoly
3. Price determination of public utilities
4. Price determination of joint products
5. Wage determination
6. International trade
7. Importance to finance minister

Income Elasticity of Demand (E_Y)

- Income elasticity of demand is defined as the degree of responsiveness of demand for a commodity to the change in the income of the consumer.
- In other words, income elasticity of demand is the ratio of the percentage change in demand for a commodity to the percentage change in income.

$$E_Y = \frac{\textbf{Percentage change in quantity demanded}}{\textbf{Percentage change in income}}$$

$$= \frac{\dfrac{\textbf{Change in quantity demanded}}{\textbf{Initial quantity demanded}} \times 100}{\dfrac{\textbf{Change in income}}{\textbf{Initial income}} \times 100} = \frac{\dfrac{\Delta Q}{Q} \times 100}{\dfrac{\Delta Y}{Y} \times 100} = \frac{\Delta Q}{\Delta Y} \times \frac{Y}{Q}$$

where

E_Y = Coefficient of income elasticity of demand

Q = Initial quantity demanded

Y = Initial income

ΔQ = Change in quantity demanded

ΔY = Change in income

Types of Income Elasticity of Demand

1. **Positive Income Elasticity of Demand ($E_Y > 0$)**

- If increase in income leads to increase in demand for a commodity and decrease in income leads to decrease in demand for a commodity, it is called positive income elasticity of demand.
- The commodity, which has positive income elasticity is called normal good.
- Positive income elasticity can be divided into three types:

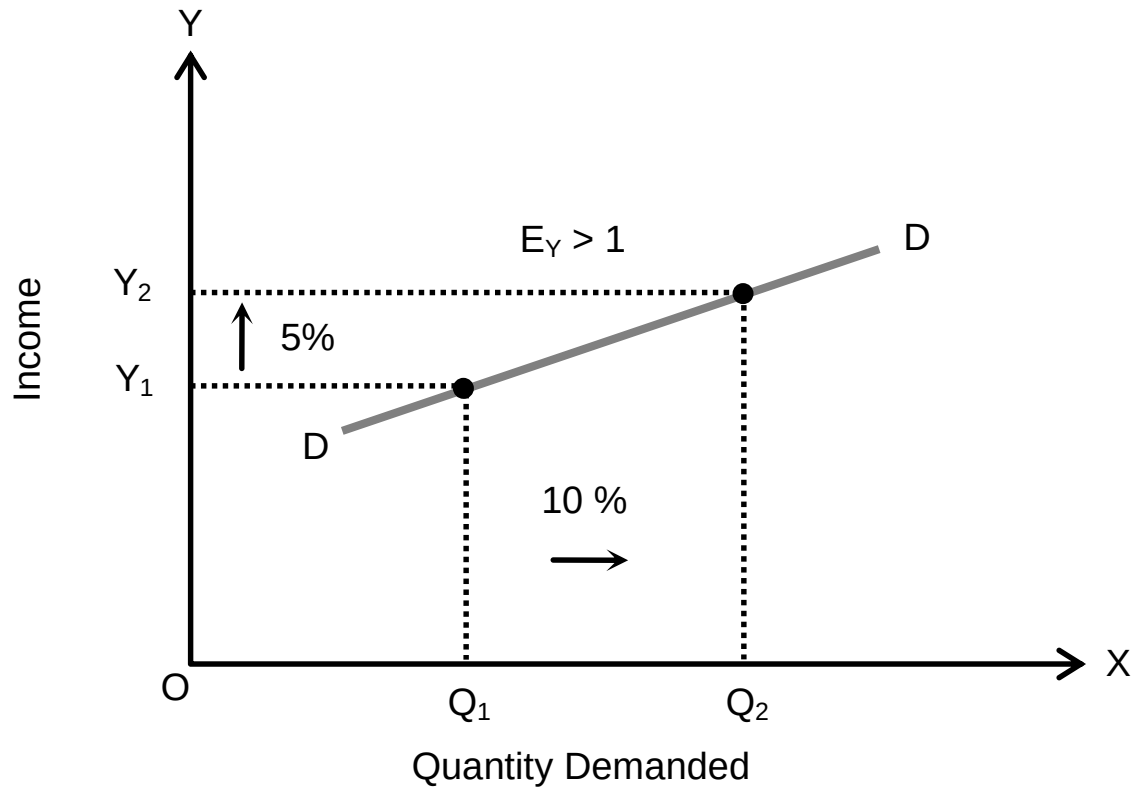
a. **Income elasticity greater than unity ($E_Y > 1$):**

b. **Income elasticity greater than unity ($E_Y > 1$):**

c. **Income elasticity equal to unity ($E_Y = 1$):**

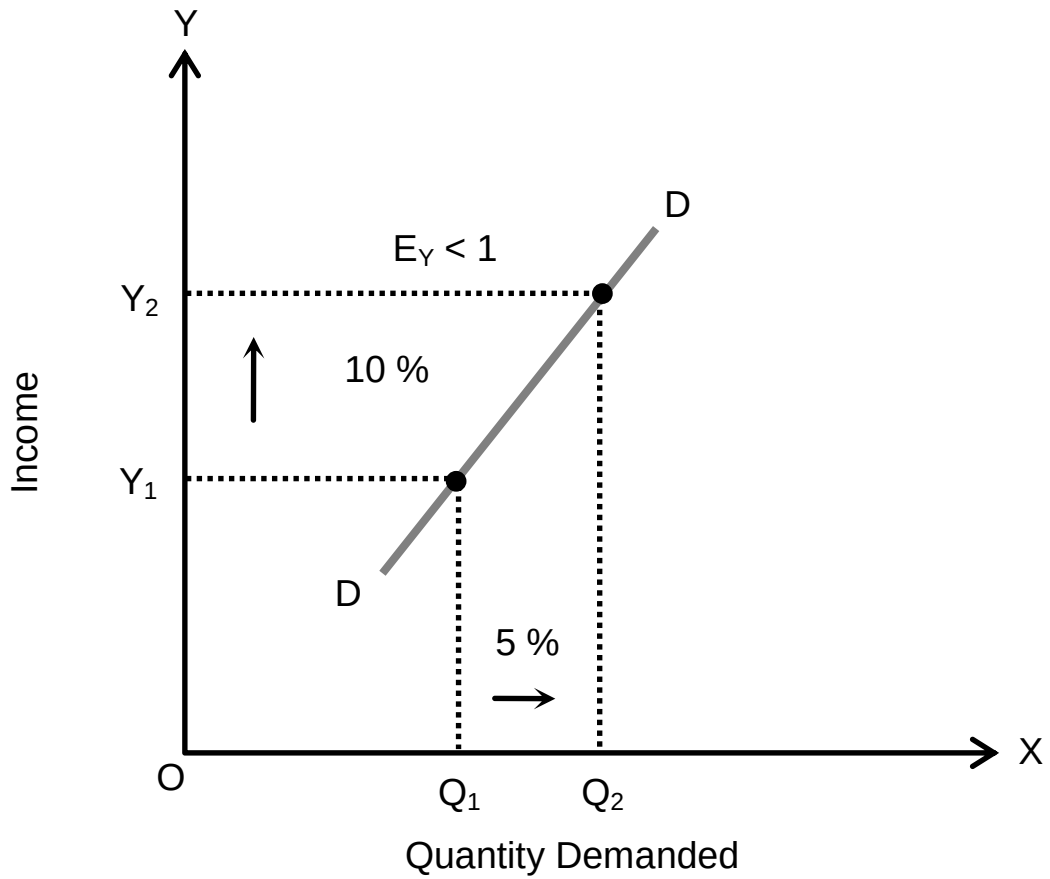
Types of Income Elasticity of Demand Contd.

a. Income elasticity greater than unity ($E_Y > 1$): The income elasticity of demand is greater than unity when the demand for a commodity increases more than percentage to rise in income.



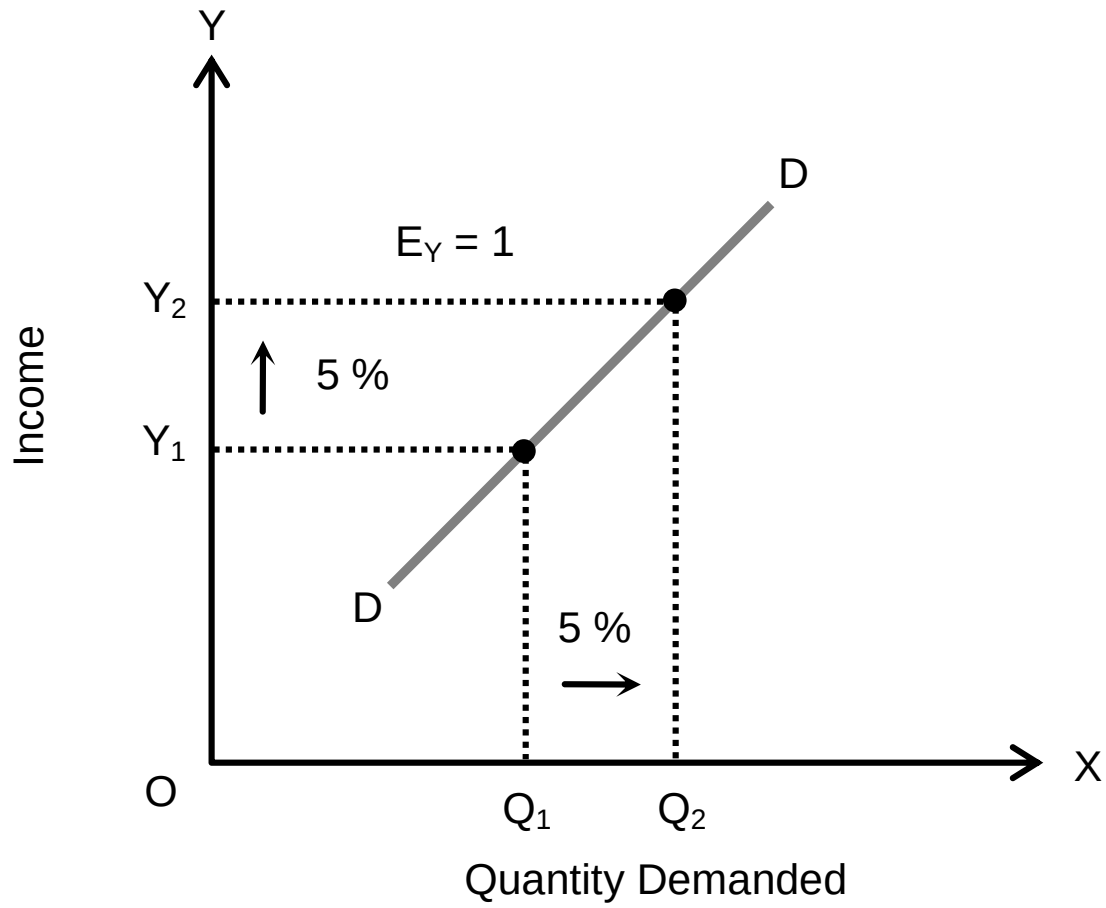
Types of Income Elasticity of Demand Contd.

b. Income elasticity greater than unity ($E_Y > 1$): Income elasticity of demand is less than unity when the demand for a commodity increases less than percentage rise in income.



Types of Income Elasticity of Demand Contd.

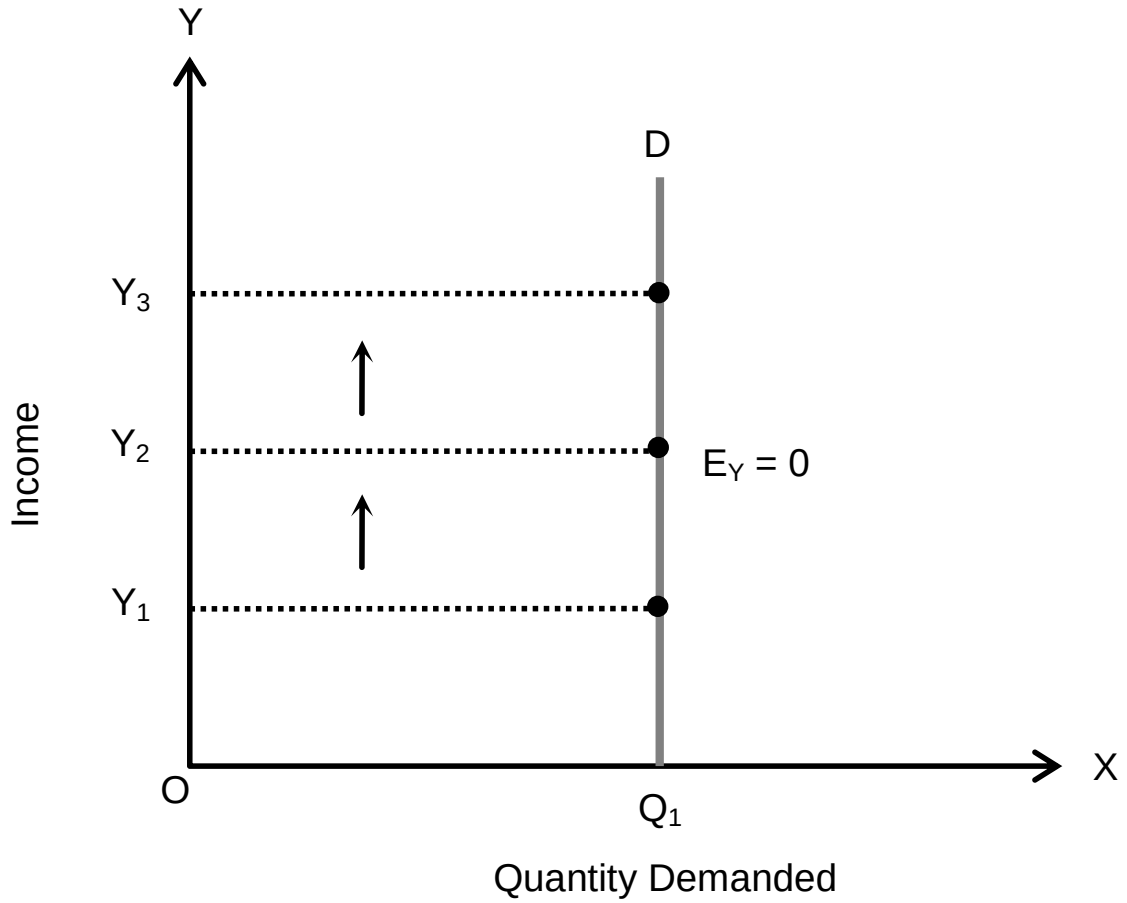
c. Income elasticity equal to unity ($E_Y = 1$): Income elasticity is unity when the demand for a commodity increases in the same proportion as the rise in income.



Types of Income Elasticity of Demand Contd.

2. Zero Income Elasticity of Demand ($E_Y = 0$)

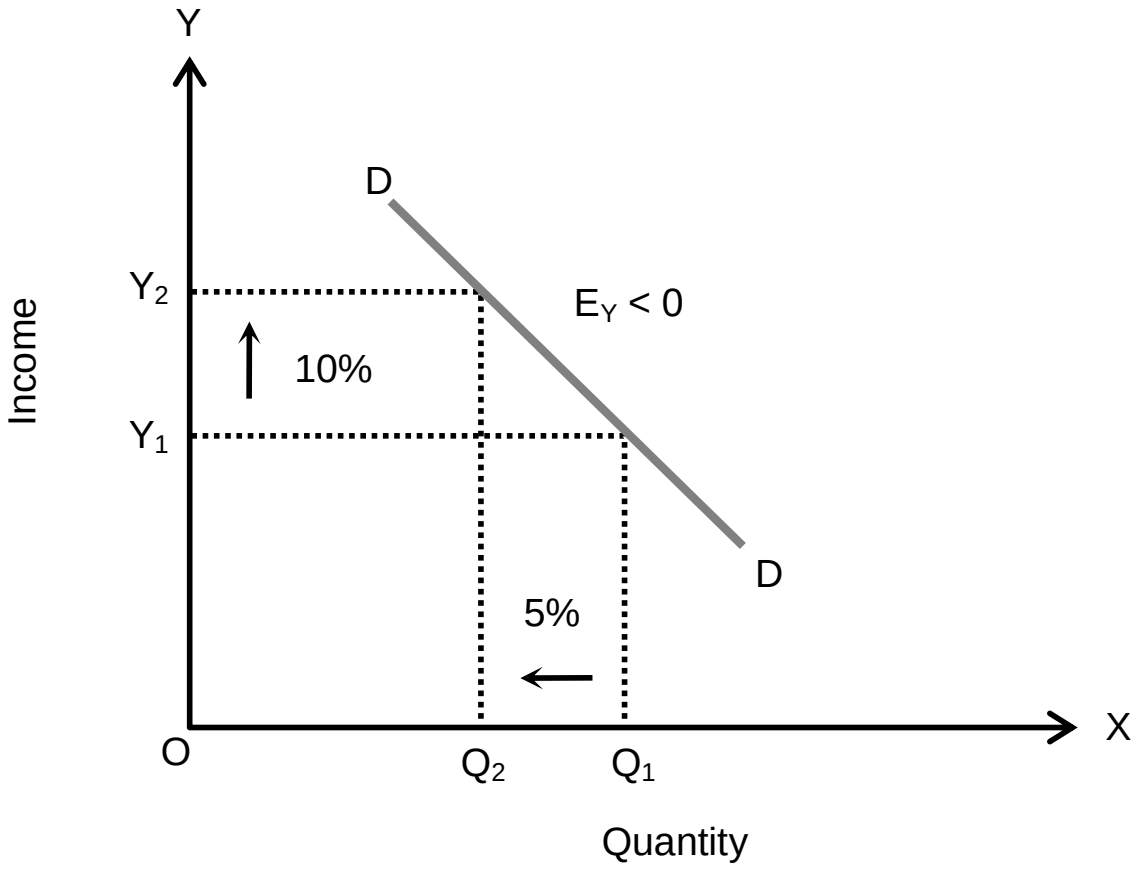
- If quantity demanded remains unchanged despite change in income and vice-versa, the income elasticity is said to be zero.
- It is found in case of neutral goods like salt.



Types of Income Elasticity of Demand Contd.

3. Negative Income Elasticity of Demand ($E_Y < 0$)

- When the consumer reduces his demand with the rise in income and vice versa, the income elasticity of demand is said to be negative.
- It is found in case of inferior or low quality goods.



Measurement of Income Elasticity of Demand

1. Percentage Method

According to the percentage method, income elasticity of demand is measured dividing percentage change in demand by percentage change in income.

$$E_Y = \frac{\text{Percentage change in demand}}{\text{Percentage change in income}}$$

$$= \frac{\frac{\Delta Q}{Q} \times 100}{\frac{\Delta Y}{Y} \times 100} = \frac{\Delta Q}{\Delta Y} \times \frac{Y}{Q}$$

where

E_Y = Income elasticity

Q = Initial quantity

ΔQ = Change in quantity

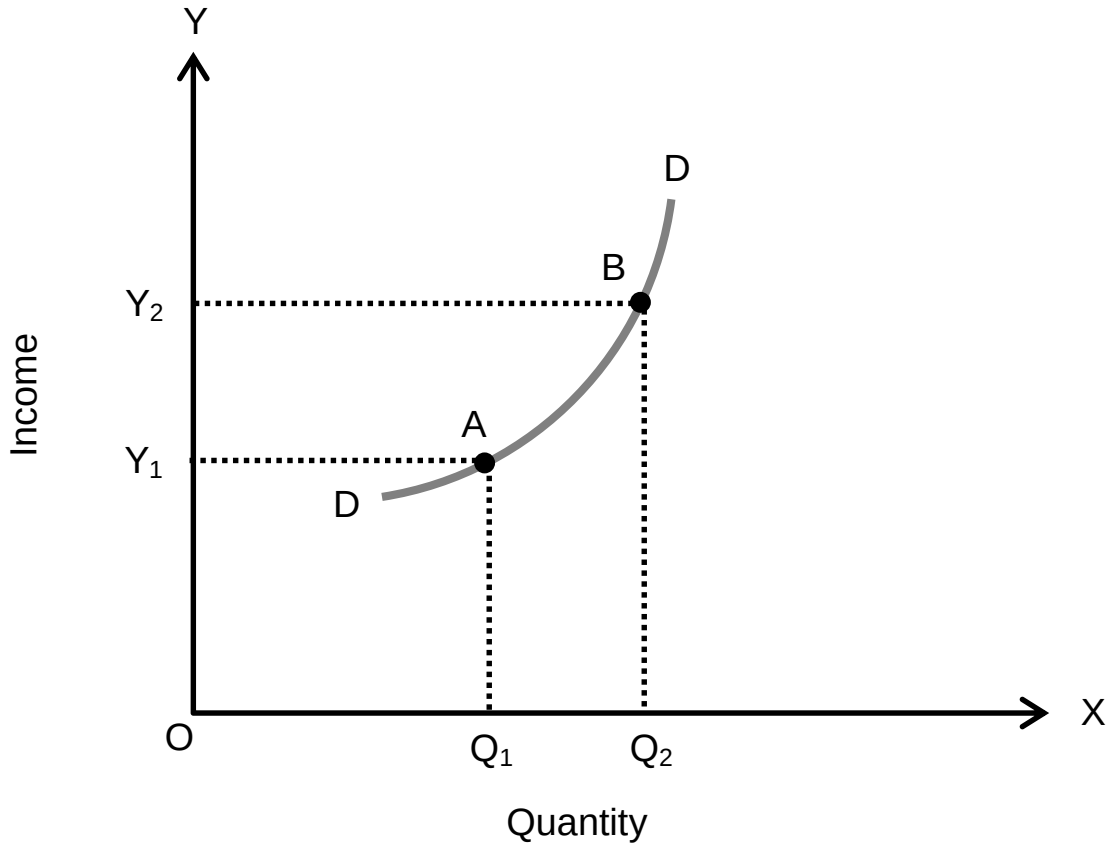
Y = Initial income

ΔY = Change in income

Measurement of Income Elasticity of Demand Contd.

2. Arc Method

- The coefficient of income elasticity of demand between two points on an income demand curve is called arc elasticity of income demand.
- This method is used when there is big change in income and demand.
- According to this method, income elasticity of the demand is the coefficient of average between two points of income- demand curve.



Measurement of Income Elasticity of Demand Contd.

Arc elasticity between point A and B income demand curve DD (E_Y),

$$E_Y = \frac{\left(\frac{\text{Change in demand}}{\text{Average demand}}\right)}{\left(\frac{\text{Change in Income}}{\text{Average Income}}\right)} = \frac{\frac{\Delta Q}{\frac{Q_1 + Q_2}{2}}}{\frac{\Delta Y}{\frac{Y_1 + Y_2}{2}}}$$

$$= \frac{\Delta Q}{\Delta Y} \times \left(\frac{Y_1 + Y_2}{Q_1 + Q_2}\right) = \left(\frac{Q_2 - Q_1}{Y_2 - Y_1}\right)\left(\frac{Y_1 + Y_2}{Q_1 + Q_2}\right)$$

where

E_Y = Coefficient of income elasticity of demand

Q_1 = Initial quantity demanded

Q_2 = New quantity demanded

ΔQ = Change in quantity demanded

Y_1 = Initial income of the consumer

Y_2 = New income of the consumer

ΔY = Change in income

Uses or Importance of Income Elasticity of Demand

1. Useful to know about stage of trade cycle
2. Useful for forecasting demand
3. Useful for classification of normal and inferior goods
4. Useful for making marketing strategy

Cross Elasticity of Demand (E_{XY})

- The cross elasticity of demand is defined as the percentage change in the quantity demanded of good X resulting from a percentage change in the price of good Y.
- In other words, the ratio of percentage change in the quantity demanded for good X to a given percentage changes in the price of good Y.

$$E_{XY} = \frac{\textbf{Percentage change in demand for good X}}{\textbf{Percentage change in price of good Y}}$$

$$= \frac{\dfrac{\textbf{Change in demand for good X}}{\textbf{Initial demand for good X}} \times 100}{\dfrac{\textbf{Change in price of good Y}}{\textbf{Initial price of good Y}} \times 100} = \frac{\dfrac{\Delta Q_X}{Q_X} \times 100}{\dfrac{\Delta P_Y}{P_Y} \times 100} = \frac{\Delta Q_X}{\Delta P_Y} \times \frac{P_Y}{Q_X}$$

where

E_{XY} = Coefficient of cross elasticity of demand

P_Y = Price of good Y

Q_X = Quantity of good X

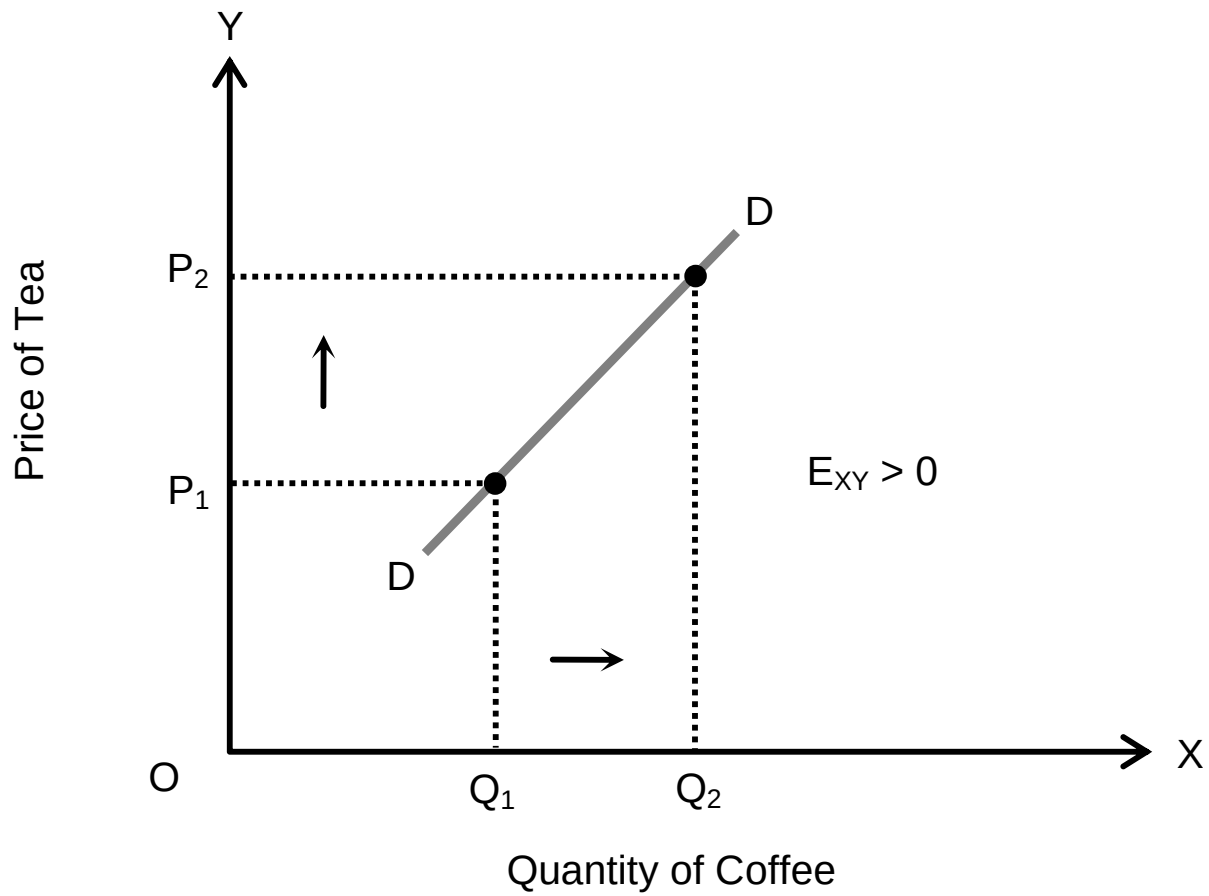
ΔP_Y = Change in the price of good Y

ΔQ_X = Change in the demand for good X

Types of Cross Elasticity of Demand

1. Positive Cross Elasticity of Demand ($E_{XY} > 0$)

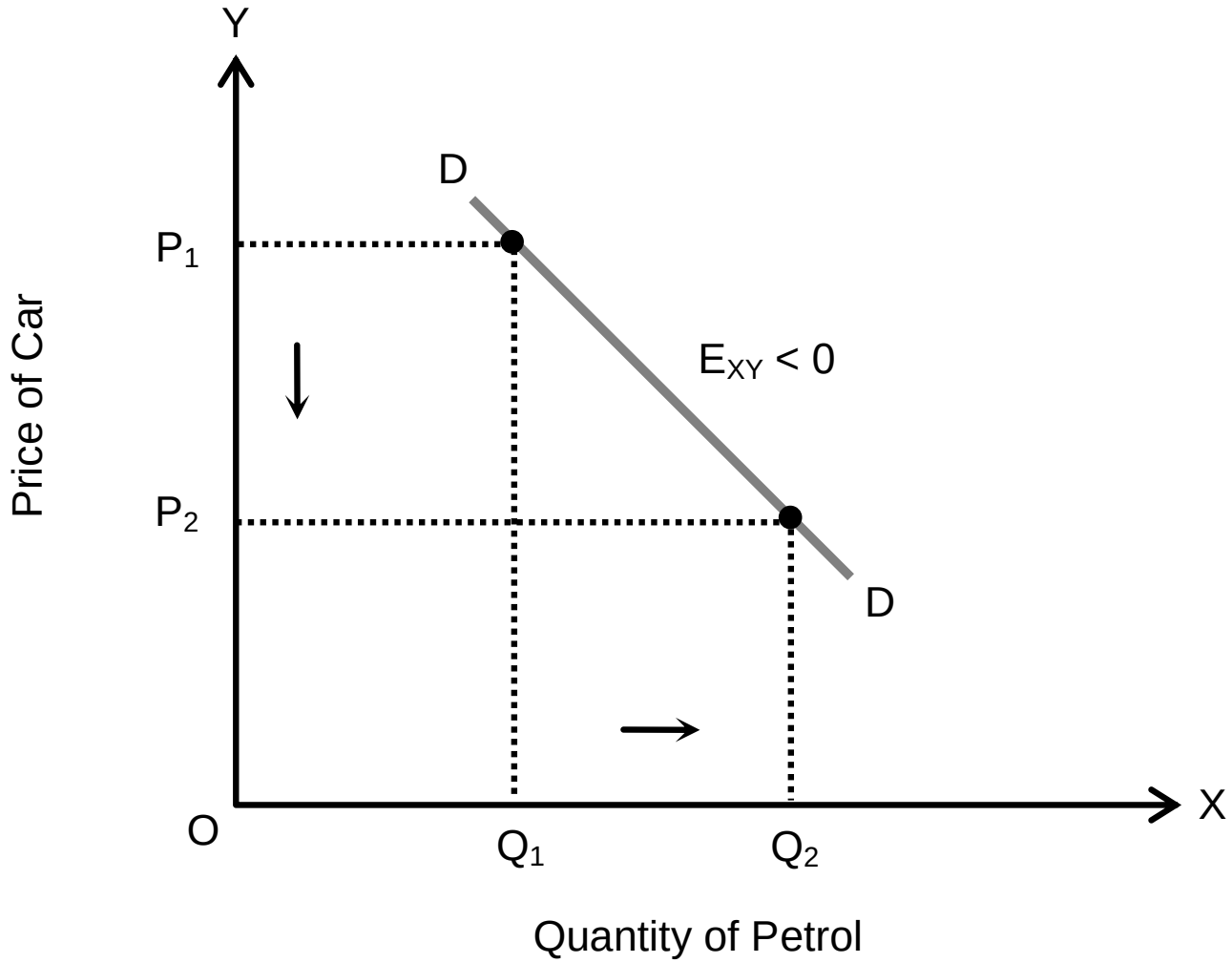
- When the demand for a commodity and price of the related commodity change into the same direction, the cross elasticity of demand is positive.
- In the case of substitute goods, the cross elasticity of demand is positive.



Types of Cross Elasticity of Demand

2. Negative Cross Elasticity of Demand ($E_{XY} < 0$)

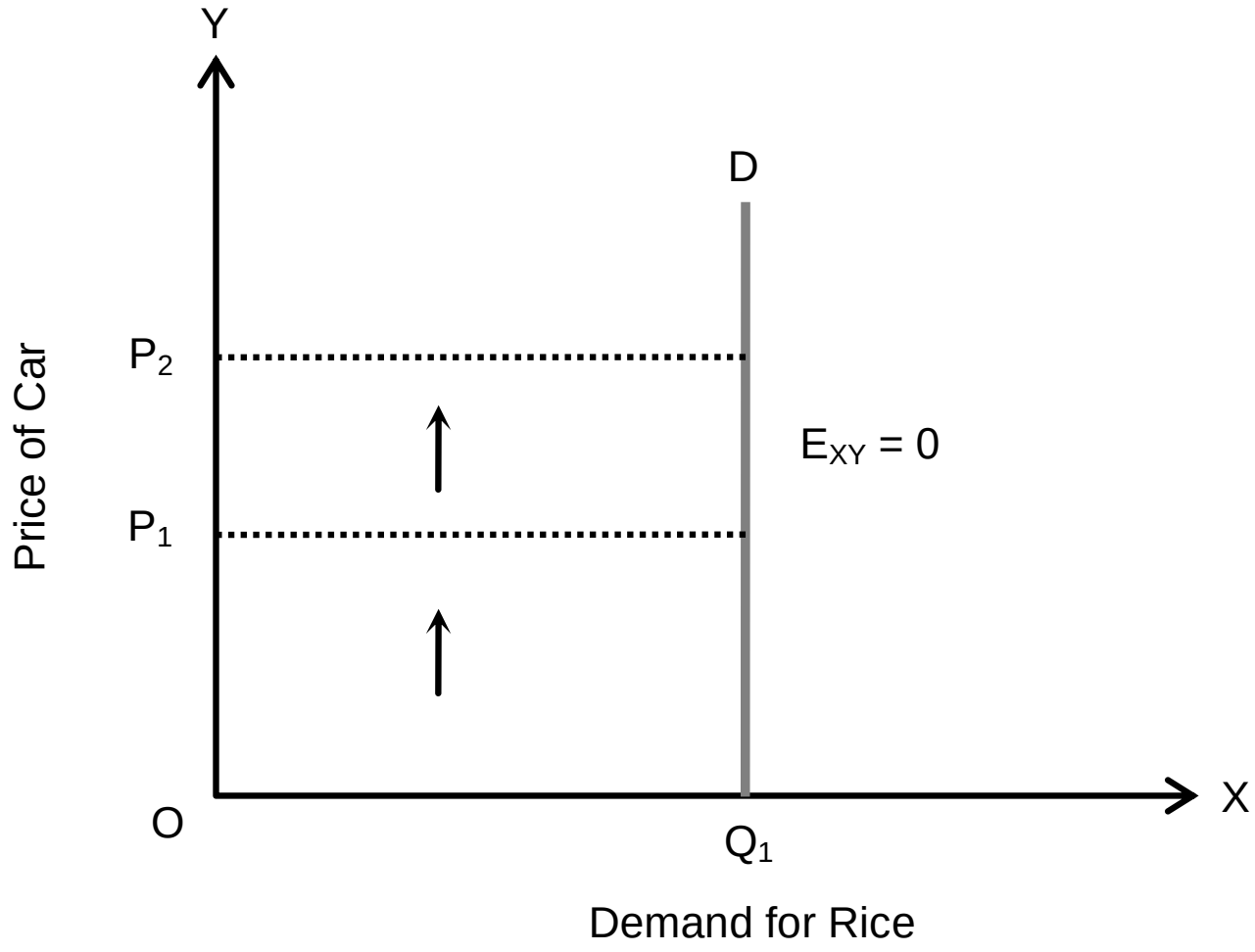
- When demand for a commodity and price of related commodity change into opposite direction, the cross elasticity of demand is negative.
- In the case of complementary goods, cross elasticity of demand is negative.



Types of Cross Elasticity of Demand

3. Zero Cross Elasticity of Demand ($E_{XY} = 0$)

- When the change in price of one good has no effect on the demand for another good, the cross elasticity of demand is zero.
- For example, price of car and demand for rice have zero cross elasticity of demand.



Measurement of Cross Elasticity of Demand

1. Percentage Method

According to percentage method, cross elasticity of demand is measured dividing percentage change in demand for a good X divided by percentage change in price of good Y.

$$E_{XY} = \frac{\text{Percentage change in demand for good X}}{\text{Percentage change in price of good Y}}$$

$$= \frac{\frac{\Delta Q_X}{Q_X} \times 100}{\frac{\Delta P_Y}{P_Y} \times 100} = \frac{\Delta Q_X}{\Delta P_Y} \times \frac{P_Y}{Q_X}$$

where

E_Y = Cross elasticity of demand between good X and good Y

Q_X = Initial quantity of good X ΔQ_X = Change in demand for good X

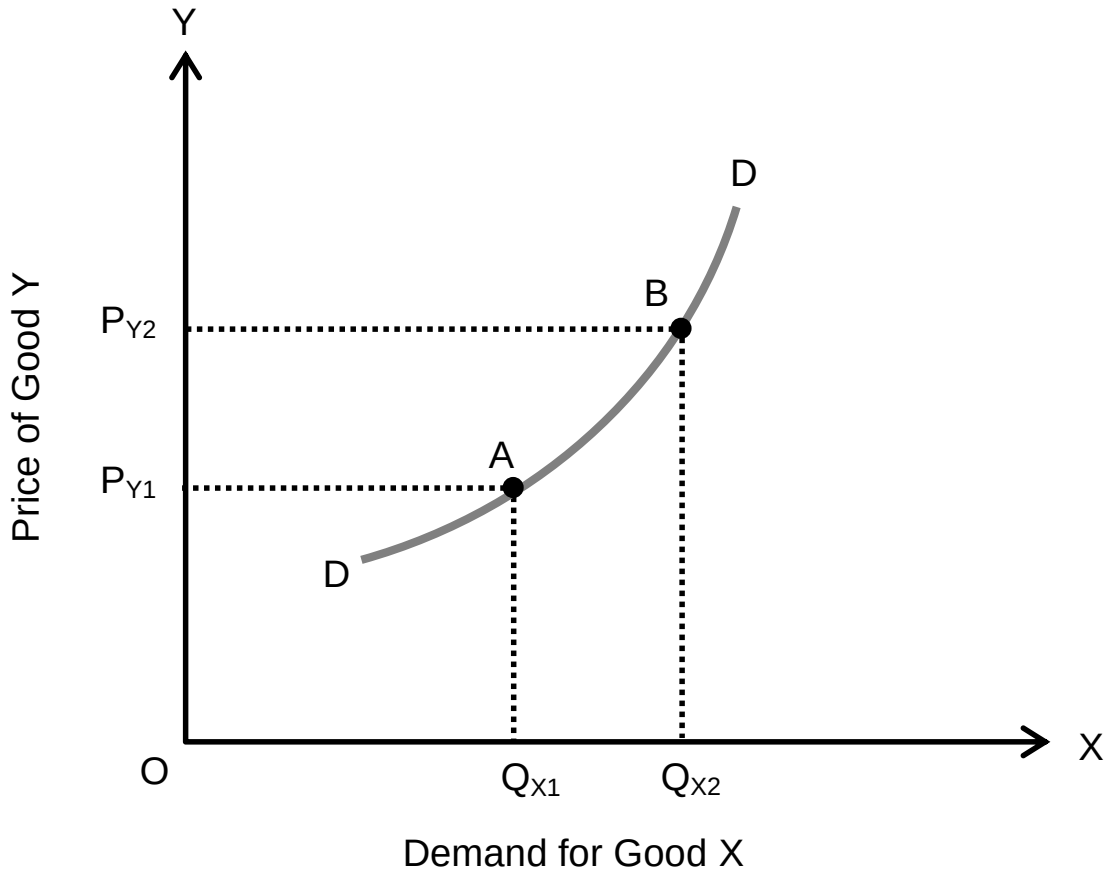
P_Y = Initial price of good Y ΔP_Y = Change in price of good Y

If $E_{XY} > 0$, the good X and good X are substitute goods, if $E_{XY} < 0$, the good X and good Y are complementary goods and if $E_{XY} = 0$, the good X and good Y are non-related goods.

Measurement of Cross Elasticity of Demand Contd.

2. Arc Method

- The coefficient of cross elasticity of demand between two points on a cross demand curve is called arc elasticity of demand.
- This method is used to measure the cross elasticity of demand when there is greater change in price and quantity demanded.
- According to this method, cross elasticity of demand is the coefficient or average between two points along a cross demand curve.



Measurement of Cross Elasticity of Demand Contd.

In figure, DD represents cross demand curve of substitute goods X and Y.

The cross elasticity between two points A and B is measured by using following formula:

$$E_{XY} = \frac{\left(\frac{\text{Change in demand for Good X}}{\text{Average demand for Good X}}\right)}{\left(\frac{\text{Change in Price of Good Y}}{\text{Average Price of Good Y}}\right)} = \frac{\frac{\Delta Q}{\frac{Q_{X1} + Q_{X2}}{2}}}{\frac{\Delta P_Y}{\frac{P_{Y1} + P_{Y2}}{2}}}$$

$$= \frac{\Delta Q_X}{\Delta P_Y} \times \left(\frac{P_{Y1} + P_{Y2}}{Q_{X1} + Q_{X2}}\right) = \left(\frac{Q_{X2} - Q_{X1}}{P_{Y2} - P_{Y1}}\right) \times \left(\frac{P_{Y1} + P_{Y2}}{Q_{X1} + Q_{X2}}\right)$$

where

E_{XY} = Coefficient of cross elasticity of demand

Q_{X1} = Initial demand for good X

Q_{X2} = New demand for good X

P_{Y1} = Initial price of good Y

P_{Y2} = New price of good Y

Measurement of Cross Elasticity of Demand Contd.

If good X and good Y are complementary goods, the cross demand curve will slope downward but method of measuring cross elasticity of demand by arc method will be same.

If $E_{XY} > 0$, the good X and good Y are substitute goods; if $E_{XY} < 0$, the good X and good Y are complementary goods and if $E_{XY} = 0$, the good X and good Y are non- related goods.

Uses or Importance of Cross Elasticity of Demand

1. Classification of goods
2. Classification of market
3. Pricing policy
4. Determination of boundaries between industries

Determinants of Elasticity of Demand

1. Nature of the commodity
2. Substitute
3. Goods having several uses
4. Joint demand
5. Income of the consumer
6. Postpone of the consumption
7. Habits
8. Price level
9. Time factor

Elasticity of Supply

The elasticity of supply is defined as the ratio between percentage change in quantity supplied and percentage change in price of a commodity.

$$E_s = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

$$= \frac{\dfrac{\text{Change in quantity supplied}}{\text{Initial quantity supplied}} \times 100}{\dfrac{\text{Change in price}}{\text{Initial price}} \times 100} = \frac{\dfrac{\Delta Q}{Q} \times 100}{\dfrac{\Delta P}{P} \times 100} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

where

E_S = Coefficient of elasticity of supply

P = Initial price

Q = Initial quantity supplied

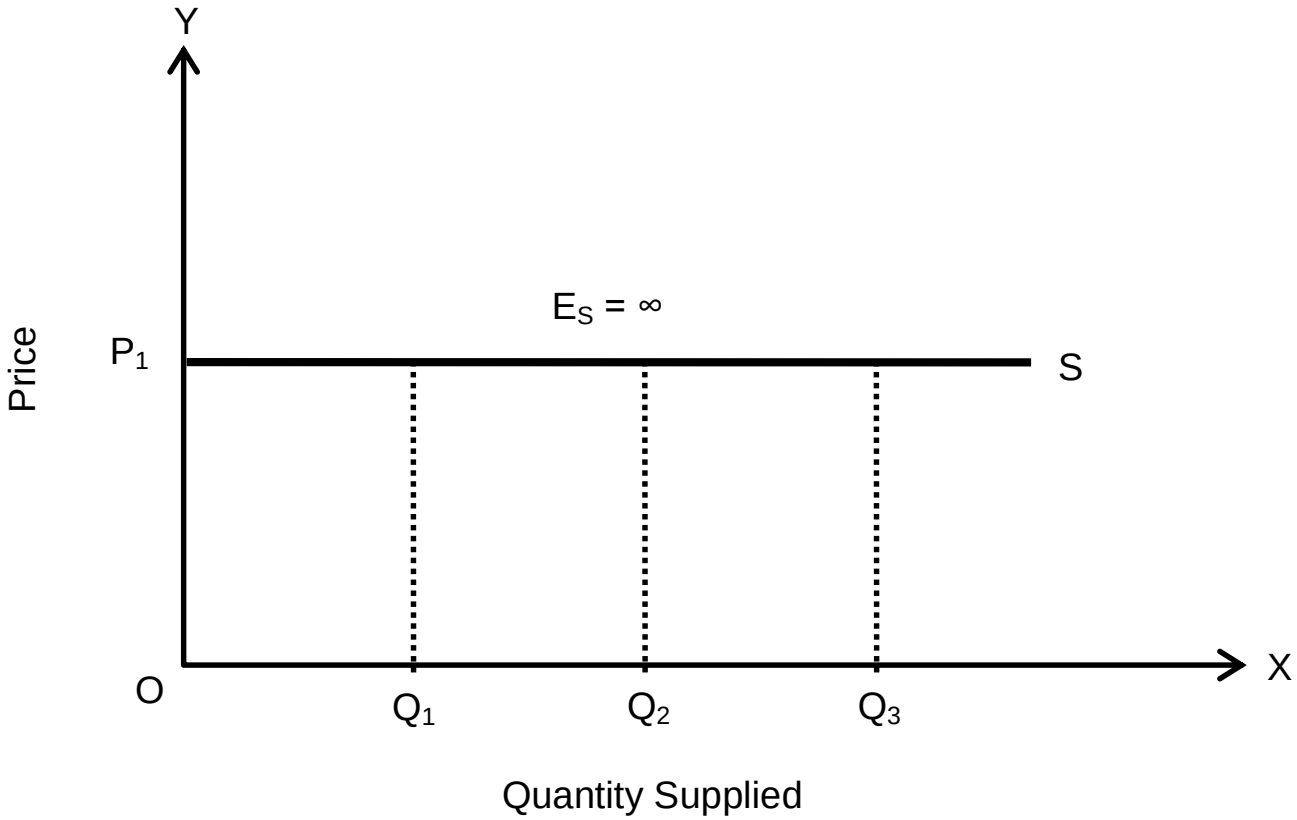
ΔP = Change in price

ΔQ = Change in quantity supplied

Types (Degrees) Price of Elasticity of Supply

1. Perfectly Elastic Supply ($E_S = \infty$)

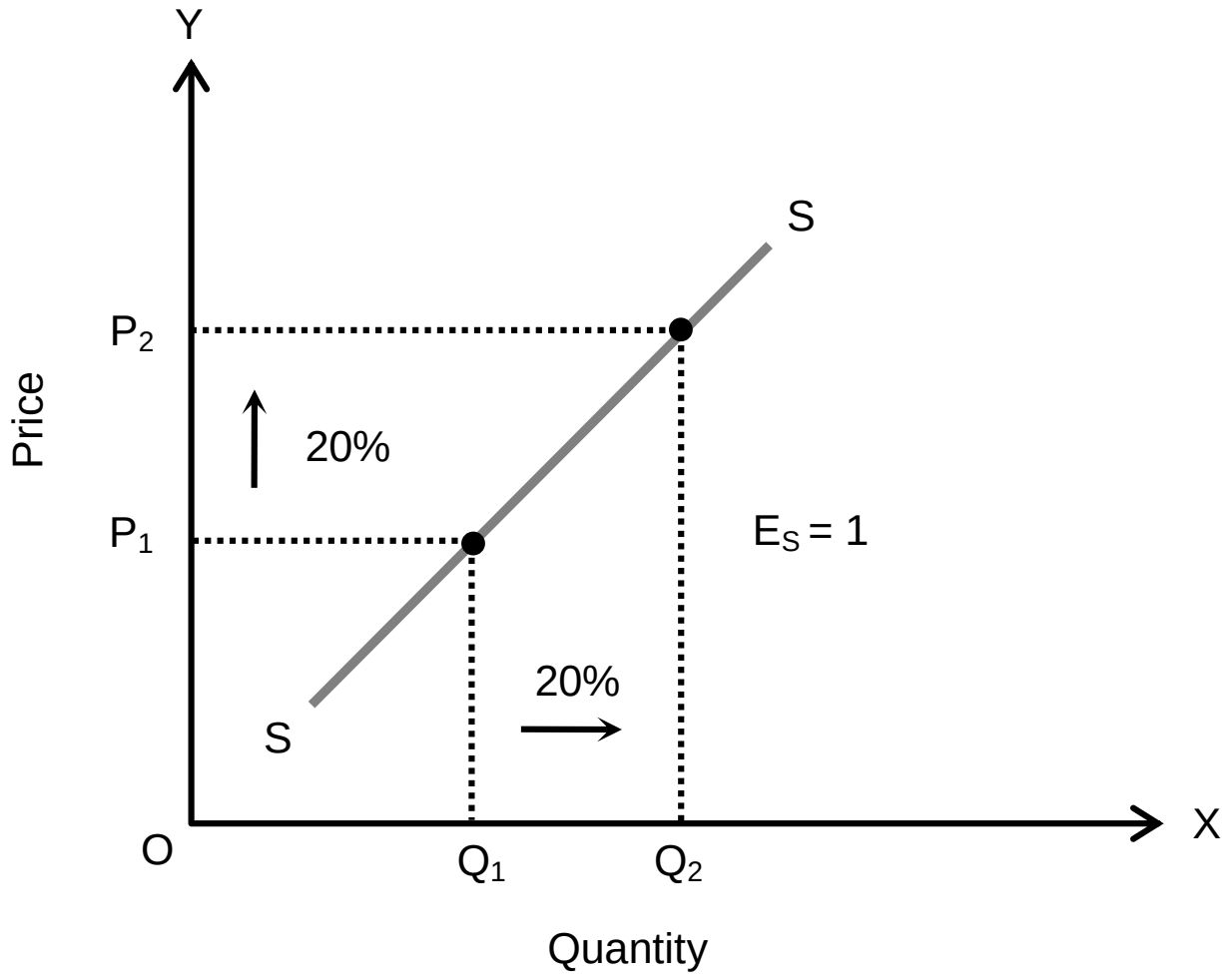
- Supply is said to be perfectly elastic supply if negligible change in price leads to infinite change in the quantity supplied.
- Visibly, no change in price causes infinite change in supply. It is shown in figure.



Types (Degrees) Price of Elasticity of Supply Contd.

2. Perfectly Inelastic Supply ($E_S = 0$)

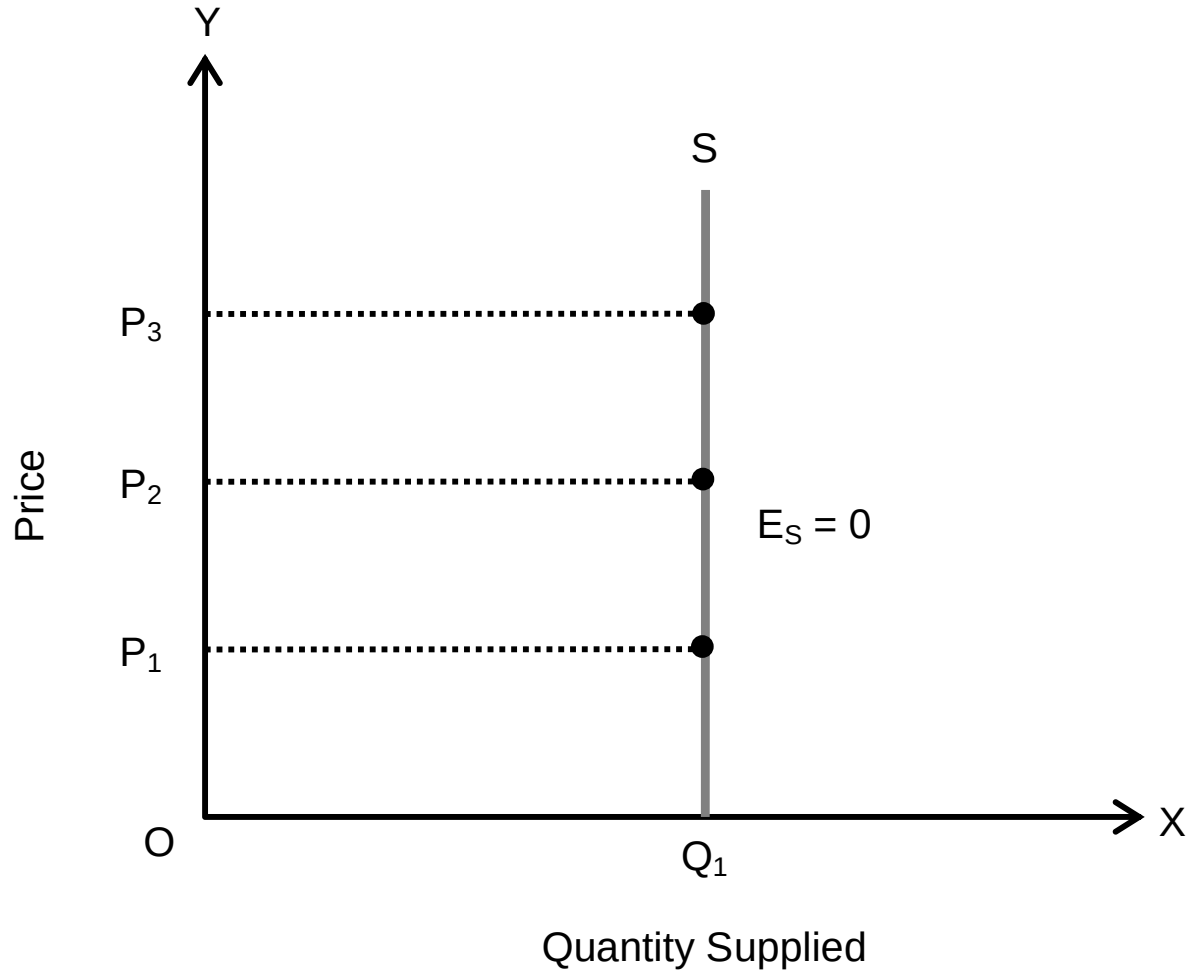
When the supply of a commodity does not change despite the change price, the supply is said to perfectly inelastic supply.



Types (Degrees) Price of Elasticity of Supply Contd.

2. Perfectly Inelastic Supply ($E_S = 0$)

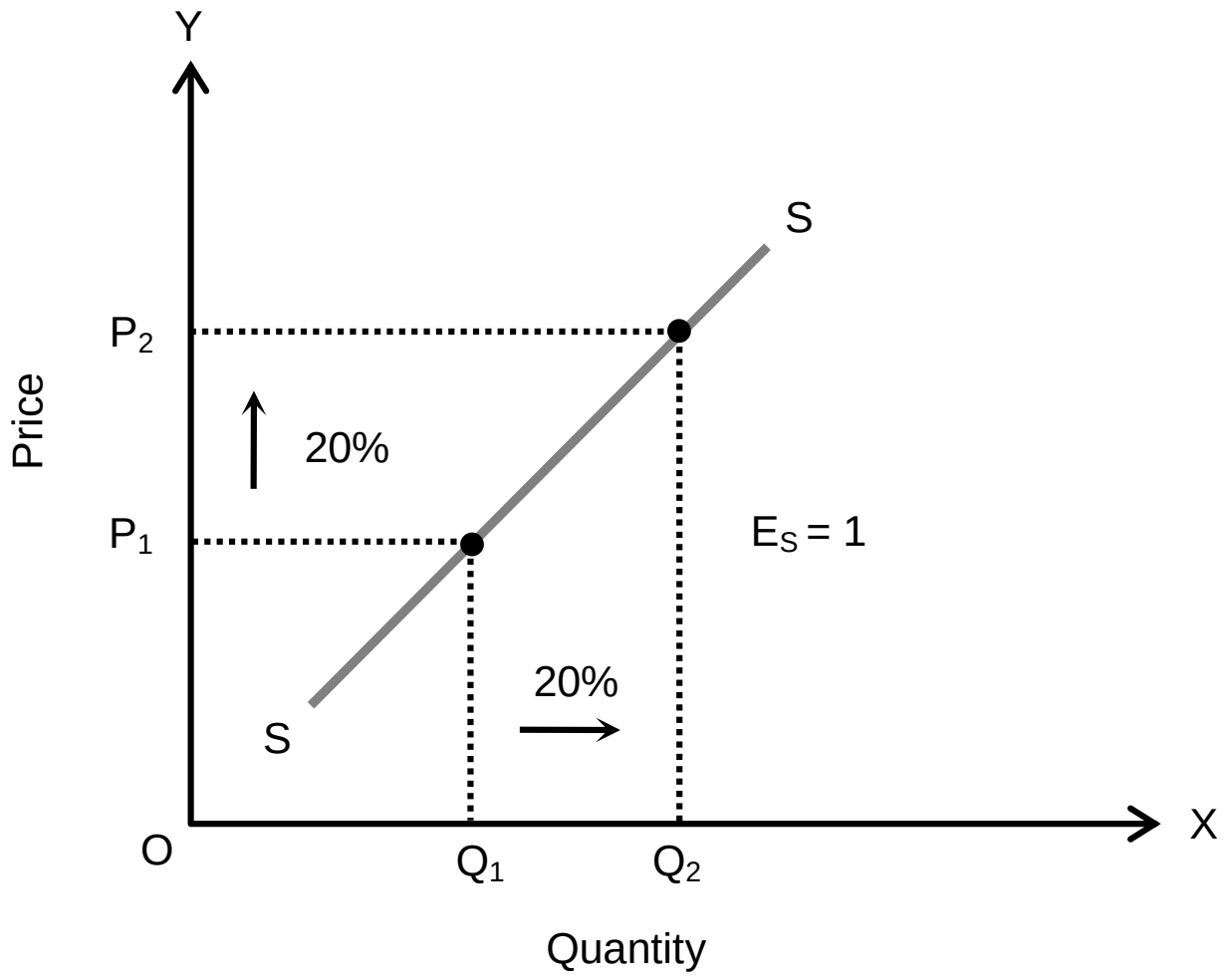
When the supply of a commodity does not change despite the change price, the supply is said to perfectly inelastic supply.



Types (Degrees) Price of Elasticity of Supply Contd.

3. Unitary Elastic Supply ($E_S = 1$)

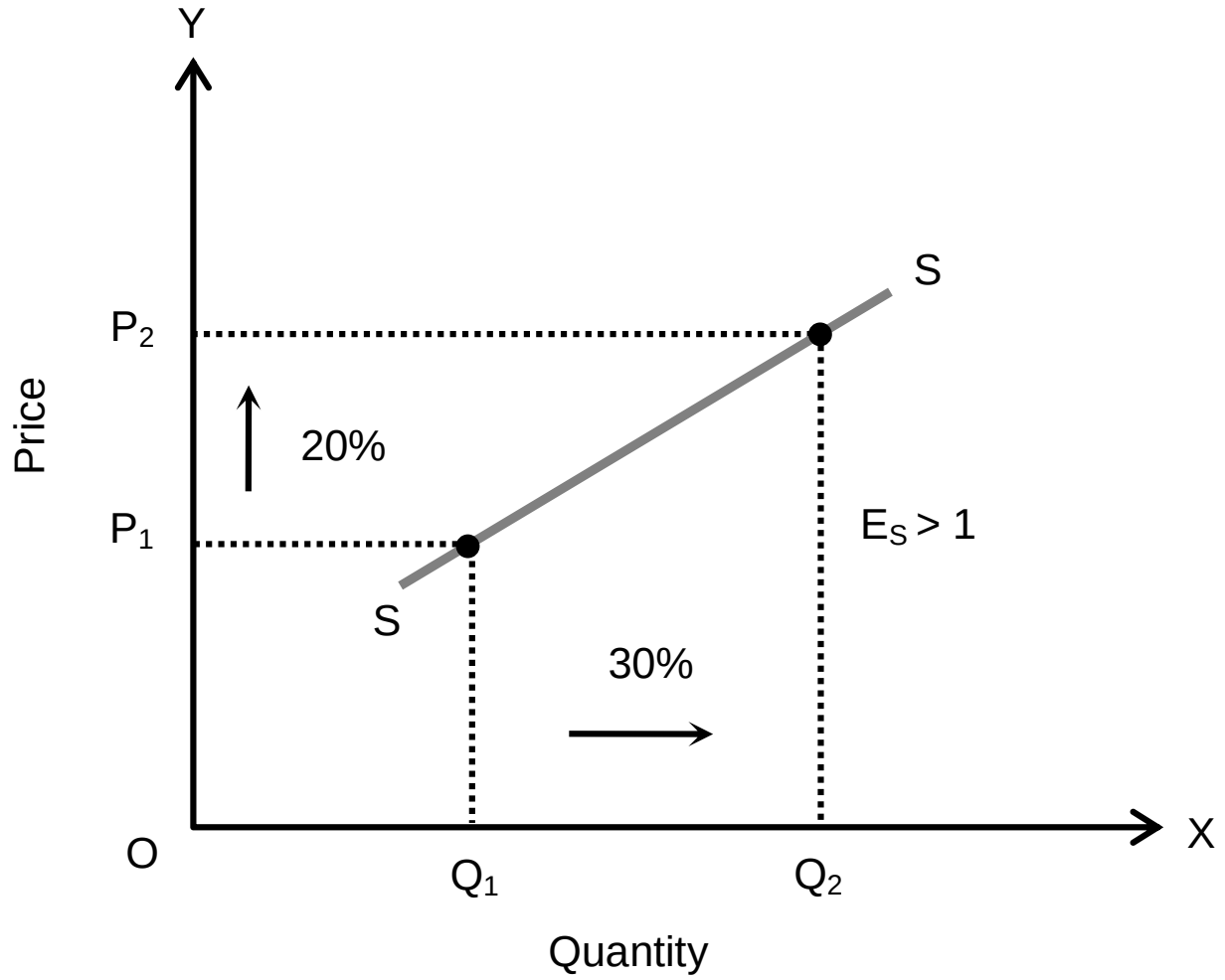
When the percentage change in the quantity supplied is equal to the percentage change in price, the supply of a commodity is said to be unitary elastic.



Types (Degrees) Price of Elasticity of Supply Contd.

4. Relatively Elastic Supply ($E_S > 1$)

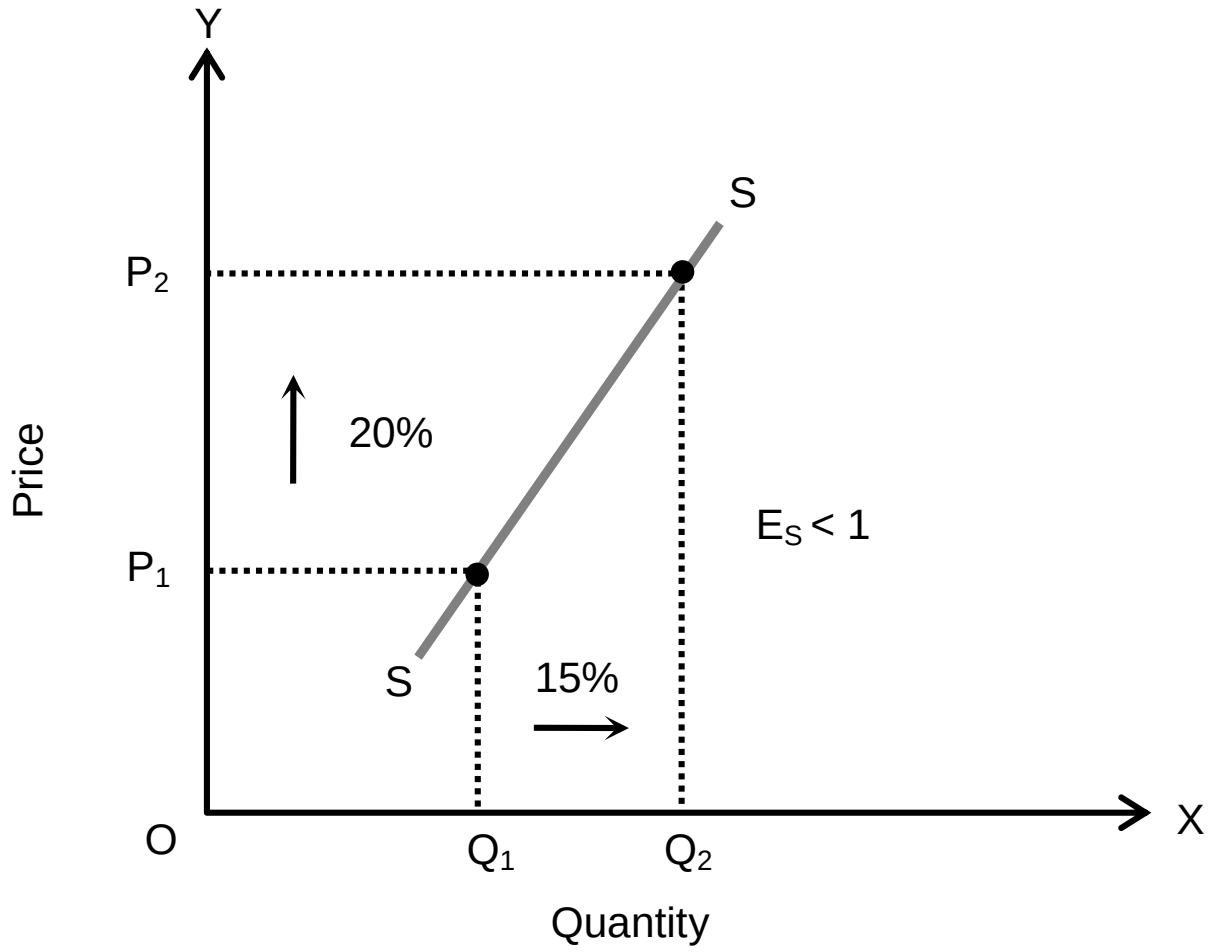
- When the percentage change in the quantity supplied of a commodity is more than the percentage change in price, it is called relatively elastic supply.
- It is also called elasticity greater than unity.



Types (Degrees) Price of Elasticity of Supply Contd.

5. Relatively Inelastic Supply ($E_S < 1$)

- When the percentage change in the quantity supplied of a commodity is less than percentage change in price, it is called relatively inelastic supply.
- It is also called elasticity less than unity.



Measurement of Elasticity of Supply

1. Percentage Method

According to this method, elasticity of supply is calculated dividing percentage change in quantity supplied divided by percentage change in price.

$$E_S = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

$$= \frac{\left(\frac{\text{Change in quantity supplied}}{\text{Initial quantity supplied}} \times 100\right)}{\left(\frac{\text{Change in Price}}{\text{Initial Price}} \times 100\right)} = \frac{\frac{\Delta Q}{Q} \times 100}{\frac{\Delta P}{P} \times 100} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

where

E_S = Coefficient of elasticity of supply

Q = Initial quantity supplied

ΔQ = Change in quantity supplied

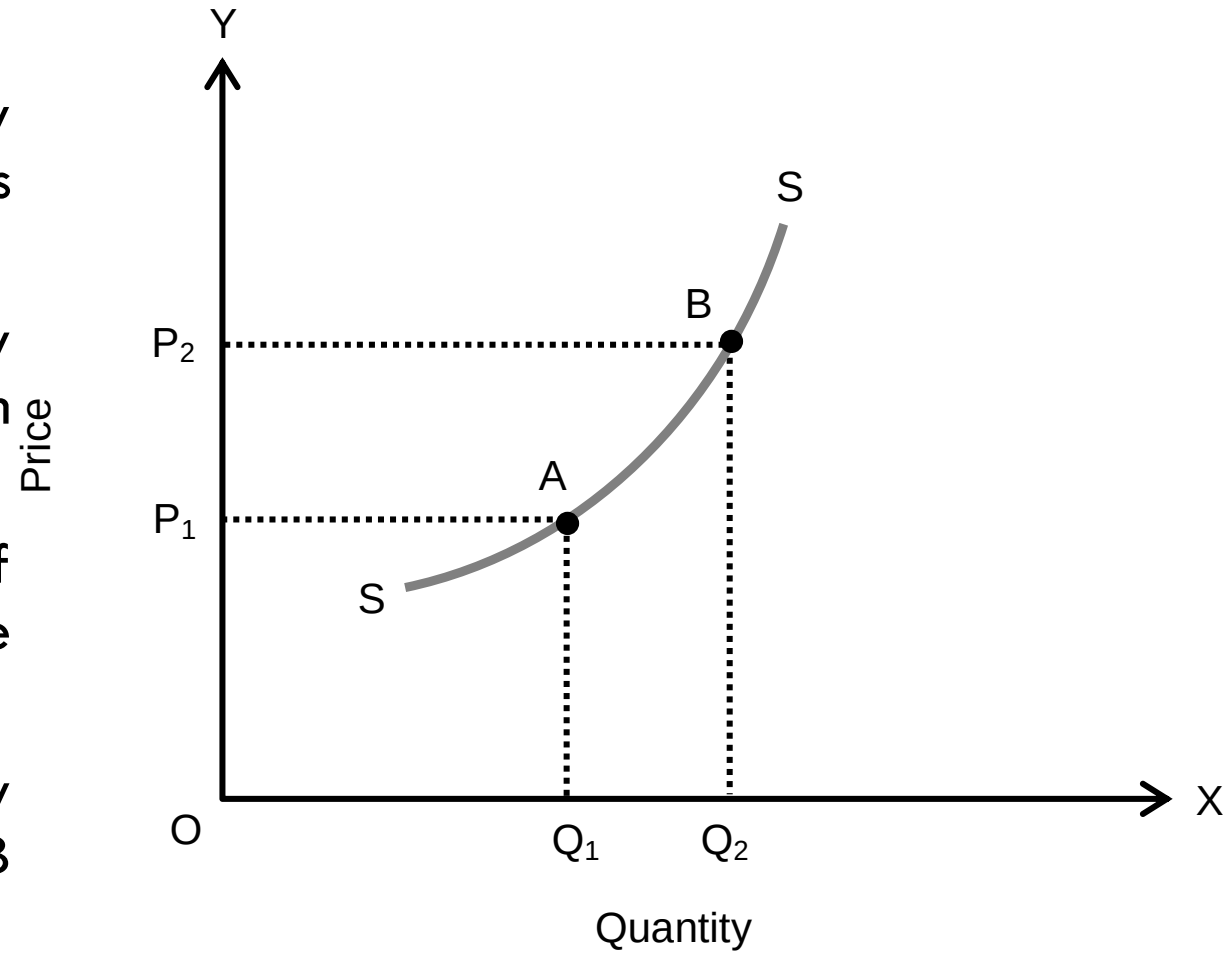
P = Initial Price

ΔP = Change in price

Measurement of Elasticity of Supply Contd.

2. Arc Method

- The coefficient of elasticity of supply between two points on a supply curve is called arc elasticity of supply.
- This method is used to measure elasticity of supply when there is greater change in price and quantity supplied.
- According to this method, elasticity of supply is the coefficient of average between two points along a supply curve.
- Figure shows the measurement of elasticity of supply between two points A and B along the supply curve SS.



Measurement of Elasticity of Supply Contd.

$$E_S = \frac{\left(\frac{\text{Change in quantity supplied}}{\text{Average quantity supplied}}\right)}{\left(\frac{\text{Change in Price}}{\text{Average Price}}\right)} = \frac{\left(\frac{\Delta Q}{\frac{Q_1 + Q_2}{2}}\right)}{\left(\frac{\Delta P}{\frac{P_1 + P_2}{2}}\right)}$$

$$= \frac{\Delta Q}{\Delta P} \times \left(\frac{P_1 + P_2}{Q_1 + Q_2}\right) = \left(\frac{Q_2 - Q_1}{P_2 - P_1}\right)\left(\frac{P_1 + P_2}{Q_1 + Q_2}\right)$$

where

E_S = Coefficient of elasticity of supply

Q_1 = Initial quantity supplied

Q_2 = New quantity supplied

P_1 = Initial price

P_2 = New price

Measurement of Elasticity of Supply Contd.

3. Point Method

- Point method is used to measure price elasticity of supply when there is very small change in price and quantity supplied.
- It is the measure of the percentage change in quantity supplied in response to a very small percentage change in price.
- To calculate the elasticity of supply at any point of a supply curve, the following formula is used:

$$E_S = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

where

E_S = Coefficient of elasticity of supply

P = Initial price

Q = Initial quantity supplied

ΔP = Change in price

ΔQ = Change in quantity supplied

The elasticity of supply depends upon the nature and slope of the supply curve. Therefore, the measurement of elasticity of supply is varied as follows:

Factors Influencing Elasticity of Supply

1. Nature of the commodity
2. Cost of production
3. Time element
4. Producers expectation
5. Technical condition of production

Numerical Examples 1

Derive demand function from the following demand schedule:

P_X	40	30	20	10	0
Q_X	0	100	200	300	400

SOLUTION

According to question

Autonomous demand (a) = 400

$$\text{Slope of demand curve (b)} = -\frac{\Delta Q}{\Delta P} = -\left(\frac{100}{-10}\right) = 10$$

We know that

Demand function: $Q_X = a - bP_X$

or, $Q_X = 400 - 10P_X$

Numerical Examples 2

Let, autonomous demand is 10 and slope of the demand curve is 2. Derive the linear demand function.

SOLUTION

Given

Autonomous demand (a) = 10

Slope of the demand curve (b) = 2

We know that

Supply function, $Q_X = a - bP_X$

or, $Q_X = 10 - 2P_X$

Numerical Examples 3

Suppose the demand function $Q_d = 1000–20P$ and supply function $Q_s = 100 +40P$

a. Fill up the table given below.

Price (in Rs.)	Quantity Demanded (Q_d)	Quantity Supplied (Q_s)
5		
10		
15		
20		
25		

b. Find equilibrium price and quantity algebraically.

c. Show Qd, Qs and prices in the graph.

SOLUTION

a. Given

Demand function, (Qd) = 1000 – 20P

Supply function, (Qs) =100 + 40P.

Thus,

Price (in Rs.)	Quantity demanded (Q_d) = 1000 – 20P	Quantity supplied (Q_s) = 100 + 40P
5	1000 – 20 × 5 = 900	**100 + 40 × 5 = 300**
10	1000 – 20 × 10 = 800	**100 + 40 × 10 = 500**
15	1000 – 20 × 15 = 700	**100 + 40 × 15 = 700**
20	1000 – 20 × 20 = 600	**100 + 40 × 20 = 900**
25	**1000 – 20 × 25 = 500**	**100 + 40 × 25 = 1100**

b. Given

$Q_d = 1000 - 20P$ and $Q_s = 100 + 40P$

For market equilibrium, $Q_d = Q_s$

or $1000 - 20P = 100 + 40P$

or $60P = 900$

or $P = 15$

Thus, equilibrium price = Rs. 15

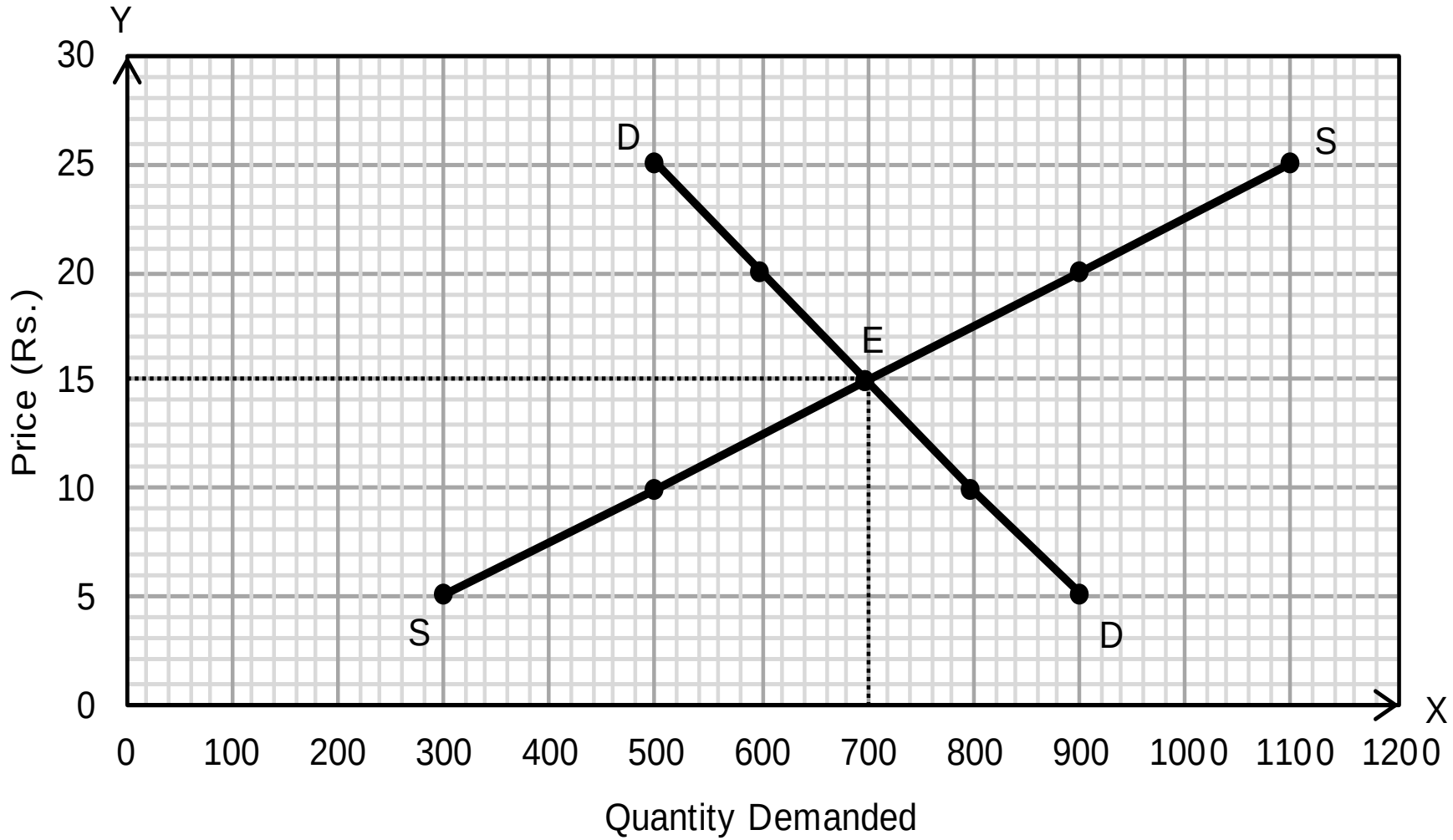
Putting the value of P in demand and supply function, we get

$Q_d = 1000 - 20 \times 15 = 700$

$Q_s = 100 + 40 \times 15 = 700$

Thus, equilibrium quantity = 700 units

c. Diagrammatic representation of Qd, Qs and price.



Numerical Examples 4

The demand function for a commodity is $Q = 100 - 5P$. Find out point elasticity at price Rs. 10.

SOLUTION

Here,

Initial price = Rs. 10

Initial quantity demanded (Q) $= 100 - 5P$

$= 100 - 5 \times 10 = 50$

We know that

$$\frac{dQ}{dP} = \frac{d(100 - 5P)}{dP} = -5$$

$$\text{Point Elasticity } (E_P) = \frac{dQ}{dP} \times \frac{P}{Q} = -5 \times \frac{10}{50} = -1$$

Since $E_P = -1$, it is the case of unitary price elasticity of demand.

Numerical Examples 5

Calculate the price elasticity of demand by proportionate and arc method when price decreases from Rs. 20 to Rs. 10 in the following example:

Price (Rs.)	20	10
Demand	40	80

SOLUTION

Proportionate Method

Initial price (P) = Rs. 20

New price (P_1) = Rs. 10

$\Delta P = -10$

Initial quantity (Q) = 40

New quantity (Q_1) = 80

$\Delta Q = 40$

$$E_P = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \frac{40}{-10} \times \frac{20}{40} = -2$$

Since $E_P = -2$, the demand is relatively elastic.

Arc Method/ Mid Point Method/ Average Method

$$E_P = \frac{Q_2 - Q_1}{P_2 - P_1} \times \frac{P_1 + P_2}{Q_1 + Q_2} = \frac{80 - 40}{10 - 20} \times \frac{20 + 10}{40 + 80} = -1$$

Since $E_P = -1$, the demand is unitary price elastic.

Numerical Examples 6

Suppose a following demand schedule:

Price (Rs.)	100	80	60	40	20	0
Demand	100	200	300	400	500	600

a. Find the elasticity for the fall in price from the Rs. 80 to Rs. 60.

b. Calculate the elasticity for the increase in price from Rs. 60 to Rs. 80.

SOLUTION

a. Here

Initial price (P) = Rs. 80 Initial quantity (Q) = 200 units

New price (P_1) = Rs. 60 New quantity (Q_1) = 300 units

$\Delta P = P_1 - P = 60 - 80 = -$ Rs. 20 $\Delta Q = Q_1 - Q = 300 - 200 = 100$ units

We know that

$$E_P = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \frac{100}{-20} \times \frac{80}{200} = -2$$

b. Here

Initial price (P) = Rs. 60 Initial quantity (Q) = 300 units

New price (P_1) = Rs. 80 New quantity (Q_1) = 200 units

$\Delta P = P_1 - P = 80 - 60 =$ Rs. 20 $\Delta Q = Q_1 - Q = 200 - 300 = -100$ units

We know that

$$E_P = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \frac{-100}{20} \times \frac{60}{300} = -1$$

Numerical Examples 7

Consider the following supply schedule:

Points	A	B	C	D
Price (P_X)	0	5	10	15
Supply (Q_X)	10	20	30	40

a. Compute the price elasticity of supply at the movement from B to C by percentage method.

b. Compute the price elasticity of supply by arc method between C and D.

SOLUTION

a. Initial quantity supplied (Q_X) = 20

New quantity supplied (Q_{X1}) = 30

Change in quantity supplied (ΔQ_X) = $Q_{X1} - Q_X = 30 - 20 = 10$

Initial price of good X (P_X) = Rs. 5

New price of good X (P_{X1}) = Rs. 10

Change in price of good X (ΔP_X) = 10 – 5 = 5

We know that

$$E_S = \frac{\Delta Q_X}{\Delta P_Y} \times \frac{P_Y}{Q_X} = \frac{10}{5} \times \frac{5}{20} = \frac{1}{2} = 0.5 < 1$$

Interpretation: Since $E_S = 0.5 < 1$, the supply is relatively inelastic. One percentage increase in price results 0.5 percentage increase in quantity supplied and vice-versa.

b. Initial quantity supplied (Q_{X1}) = 30

New quantity supplied (Q_{X2}) = 40

Initial Price (P_{X1}) = Rs. 10

New Price (P_{X2}) = Rs. 15

We know that

$$E_S = \frac{(Q_{X2} - Q_{X1})}{(P_{X2} - P_{X1})} \times \frac{(P_{X1} + P_{X2})}{(Q_{x1} + Q_{X2})}$$

$$= \frac{(40 - 30)}{(15 - 10)} \times \frac{(10 + 15)}{(30 + 40)} = \left(\frac{10}{5}\right) \times \left(\frac{25}{70}\right) = 0.71$$

Interpretation: Since, $E_S = 0.71 < 1$, the supply is relatively inelastic. One percentage increase in price results 0.71 percentage increase in quantity supplied and vice-versa.

Numerical Examples 8

In 2012, 1,000,000 units of bread were sold at Rs 30 per unit in Bhatbhateni Super Store. The price elasticity of demand for bread is – 0.2. The Bhatbhateni Superstore has decided to increase price of bread to Rs 40 per unit for 2013.

a. What will be effect on total sales of bread in 2013?

b. Compute total revenue of bread for 2012.

c. Compute total revenue of bread for 2013.

d. Suppose you are appointed as a consultant of Bhatbhateni Superstore at marketing department. What suggestion would you provide to the managing director of the superstore about this pricing decision?

SOLUTION

Given

Initial quantity of bread (Q) = 1,000,000 units

Initial price (P) = Rs. 30

Price elasticity of demand (E_P) = – 0.2

New price of bread (P_1) = Rs. 40

a. New quantity (Q_1) = ?

We know that

$$E_P = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

or, $$-0.2 = \frac{(Q_1 - Q)}{(P_1 - P)} \times \frac{P}{Q}$$

or, $$-0.2 = \frac{(Q_1 - 1{,}000{,}000)}{(40 - 30)} \times \frac{30}{1{,}000{,}000}$$

or, $-66{,}666.66 = Q_1 - 1{,}000{,}000$

$\therefore$ $Q_1 = 933{,}333.34$

The total sales of bread has increased because its demand is inelastic.

b. TR of bread for 2012 $= P \times Q$

$= 30 \times 1{,}000{,}000$

$=$ Rs. 30,000,000

c. TR of bread for 2013 $= P_1 \times Q_1$

$= 40 \times 933{,}333.34$

$=$ Rs. 37,333,333.6

d. If I were appointed as a consultant of the Bhatbhateni superstore, I would give suggestion to raise the price of bread because it has relatively inelastic demand. After increase in price, there is increase total revenue.